PATTERN OF FOOD LOSSES IN HOUSEHOLDS: A CASE STUDY IN OITA-PREFECTURE, JAPAN

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Table of Contents

List of Figures

List of Tables

Abbreviations

APU	Ritsumeikan Asia Pacific University
CAA	the Consumer Affairs Agancy of Japan
CO2	Carbon dioxide
JAS	Japanese Agricultural Standards Law
MAFF	Ministry of Agriculture, Forestry and Fisheries
MHLW	Ministry of Health, Labour and Welfare
NAFTA	North American Free Trade Agreement
NRS	New Economic Research Service
SD	Sustainable Development
USA	the United State of America
USD	United States Dollar
USDA	U.S. Department of Agriculture
UK	United Kingdom
UN	the United Nations
WHO	World Health Organization
WRAP	Waste Resources Action Programme
WTO	World Trade Organization

Abstract

Japanese households generated approximately 11 million tons of food waste in 2008. Almost half of this wasted food is edible and is known as food loss. Food loss happens in both developed and developing countries despite food shortages in the latter.

The purpose of this study is to describe the actual conditions of food losses in Japanese households using the case of Oita-prefecture compared with other developed countries such as UK and USA. It seeks to identify strategies for minimizing food losses in households. Data were collected through surveys, documentation, interviews, and observations.

This study found that people who seldom throw away food are those in their 70s or higher, living on pension and not living with their children who are now younger housewives. Educational attainment does not affect food waste behavior. 75% of respondents said they do impulse buying. Housewives who are working or employed as well as others who are impulse buyers tend to waste food. 32% of the respondents said they throw away vegetables. Households in Oita are generating about 115g per person a day of food wastes higher than Japan's national average. Oita needs better management strategies to reduce household

food losses.

People can change their behavior and reduce food wastes given enough awareness about the problem of food losses and supportive policy and regulations from government. This is particularly significant in Japan where food sufficiency rate is only 40%. It means that the other 60% are sourced from other countries. If the importation stops, Japan would experience food shortage. Minimizing food losses would mean food security in the long term.

Chapter 1

Introduction

1.1 Introduction

Japanese eating habits and food production have dramatically changed away from the traditional Japanese style towards a western style since the reconstruction following World War II. The cuisine is punctuated by fast food restaurants and convenience stores throughout Japan. Many of these stores are open 24 hours. In addition to the temporal availability of food, the source of food has also changed, as the most of food are imported from other countries. Domestic Japanese food production has dropped to 40% according to the Ministry of Agriculture, Forestry and Fisheries (MAFF, 2010). The total amount of food waste become 19 million tons and the food loss is estimated as 5 ~ 9 million tons which is 30% to 50% of the food waste. The Japanese society has become very conscious about food safety, and huge amount of food is discarded mainly because of this. Food losses have severe environmental costs. The food waste issue has to be managed as soon as possible. This is not only about solving the world food security problem, but also protecting Japanese food security and

environment. Lowering food losses is one of the potential measures for overcoming hunger (Engstrom et al., 2004; Brown University Faculty, 1990). This total amount of loss is more than what is required to feed the world's hungry , which is about 7.5 million tons (Sudou et al., 2010).

In less developed countries, approximately 900 million people suffer from malnutrition and the number is increasing. Not only are hunger and malnutrition still the greatest threats to world health, they are getting worse. In the latter half of the 1990s the number of hungry people rose by 18 million according to the Food and Agriculture Organization (Morris, 2004).

Increasing the efficiency with which food is handled will also reduce the ecological side effects from increasingly intensive agriculture and will help to reduce the demand for land (Bender, 1994; Kantor S.et.al., 1997; Engstrom, et. al, 2004). In 2005 alone, households in Japan have produced almost 11,000,000 tons of food waste and among them the food loss was about 2,000,000-4,000,000 tons. The portion of the households' food loss was 40% of the whole food loss when both industrial and household food wastes are considered.

This research hopes to determine the nature of and factors affecting household food wastes in Oita prefecture compared with Japan, United Kingdom

and USA trends. In addition this research provides recommendations to safely lessen food losses.

1.2 Background and Rationale of the Study

Both developed and developing countries of the world are committed to meet the challenges of sustainable development amidst the pervasive pressures of globalization. The issue of food wastes is related to the attainment of sustainable development and is influenced by the changes in consumption patterns brought about by globalization.

1.2.1 Sustainable development and food production

In general use, sustainability is a term that encompasses economic benefits, ecological benefits and social aspects. These components have their own implications for sustainable management of food resources. Economic considerations include is concerned with fair pricing for farmers producing agricultural products, processing and distributing costs as well as consideration sales and consumer buying them at stores. The ecological component is concerned with the maintenance of environmental balance. Ecological balance signifies a

balance among the plant and animal species, other marine and biotic creatures and the humans (human lifestyle).

Social aspect concerns with the toning of the production and the processes. It also prioritizes and seeks cooperation among citizens to make things more socially acceptable. Social aspects further demands support, recognition and appreciation for the production sector from the society and the governing bodies which creates local policies (Vermeir et al., 2008).

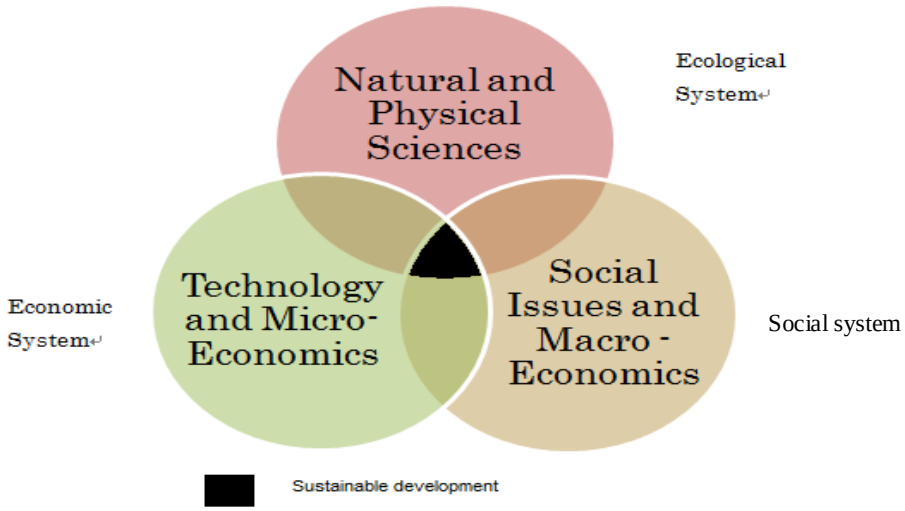


Figure 1.1: Components of Sustainable Development

Source: Cowell & Parkinson, 2003

"Sustainable development was articulated by the Brundtland Commission as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on

Environment and Development, 1987; Conwell et al., 2003). This implies that sustaining development requires the intra- and inter- generational natural equity to maintain a balance in order to provide sufficient resources for the next generation. Its central concerns are with intra- and inter-generational equity. Intra-generational indicates geographical level activities and impacts, while inter-generational equity indicates activities and impacts that occur on a differing time-scales.

Today, sustainable development has a variety of perspectives and approaches. The components of sustainable development can be represented through Fig. 1.1, illustrating the importance of the diverse disciplines such as ecology, economics and sociology in enhancing the perspectives on sustainable development (Cowell et al., 2003).

Literature on sustainable development and regionalization or localization of food production and consumption are presented based on several interconnected arguments. Various literature on reduction of environmental impacts indicate a reduction of carbon dioxide, methane and other greenhouse gases that speed up global warming and cause extreme climate change across the globe. The environmental impacts that are correlated to the transportation of food

products over long distances are reduced to a certain extent by localization of the products. Localization simply means buying products produced and sold at a local level, thereby removing the necessity to transport the goods (Brown, 2009). According to the Brown report, America and Canada found about 58 imported foods transport 2800 miles in average. When goods are produced locally and sold locally there is no occasion for transporting them over long distances. Localization has several environmental benefits. It reduces the use of fossil fuels that shrink related pollution impacts such as acidification, global warming, and photochemical smog formation (Brown, 2009). Thus, localization is a good practice to achieve sustainable development of food production and maintenance of resources for the following reasons:

1. Damaging natural resources to create farms often happen when the people desire to increase their farming opportunities by poaching on forest regions situated next to human settlements (Sustainable Table, 2010). Frequently, it is the government which induce settlers to take up forest spaces for farming purposes and there by indirectly exploiting them. Since 35 years ago, Brazilian government started to encourage the Amazon for a new agricultural farm, and that become the most serious issue for deforestation now (Food and

Agriculture Organization, 2009; University of Michigan, 2010). This way the potentials for degradation of the environment and related exploitation of human labor is reduced. It is more difficult to adopt an "out of sight, out of mind" attitude when activities are taking place in one's own backyard.

2. The waste is localized and this waste can be handled through various means. Composting, recycling home waste and reusing as fertilizers are some options for food waste management. Food production industries and restaurants need to make space for fertilizer and the feed for livestock to manage food waste in a more efficient manner (Umehara, 2003). This paves way for reducing food waste as well as managing resource use for future generation use.

3. Regionalization or localization brings people together to consider issues, factors and impacts of production and wastes. It creates a sense of oneness within a community to bring in sustainable management of resources and development. Consumers and producers create a balance in production of certain kind of food products which are essentially seasonal as they would require input of more effort and resources to produce them every season. Consumers accordingly change preferences which are best suited for the environment. This mutual understanding among the producers and consumers

comes due to localization of product, production and sales. Thus, increasing the sense of community by creating local networks of producers and consumers (Conwell et al., 2003).

1.2.2 Globalization and food consumption

Globalization comprises unlimited transport of goods, services, ideas and people. It is a process of increasing international integration in all fields (economy, politics, culture, environment, communication, etc.). This network of intensified global relations is growing at the level of individuals societies, institutions and states (Zollinger, 2007).

Globalization is conceptualized as the treaty-based liberalization of international trade among nations, a project accelerated with the formation of the European Union's Single Market (1992), the North American Free Trade Agreement (1994) and the World Trade Organization(1995). The reduction of trade barriers has enhance global economic growth and rapidly increased international trade (Curtis, 2009).

However, it can also lead to monotony. It is well known that a single production let's say rice or other grains creates infertile. In the future, especially in South America, the huge production of biomass-energy plants will cause a

massive decline in biodiversity, although, principally, the cultivation of energy plants was introduced to save the environment. Up to now, the one-sided yet necessary extraction of mineral resources in developing and emerging countries like China partly leaves behind ecological disasters of unparalleled dimensions. However, not only monoculture and overuse of natural resources cause ecological challenges, but also the necessary energy use for the global increase in production, consumption and trade. The ecological consequences of increasing globalization turn out to be the main problem of the future. However, a differentiated view is also necessary. What is intuitively regarded as being wrong, may not be wrong empirically. For instance, it appears that for English people it is ecologically more sensible to eat lamb meat from New Zealand instead of English lamb, also when considering transportation (Zollinger, 2007).

Beef is one of the most environmentally troublesome commodities as it is energy, land water and pollution intensive. Historically, low consumption levels of beef in North East Asia were the outcome of successful ecological adaptations between man and land. Grain-dominated diets have permitted high population densities and less energy consumption, as calorie yields from areas planted with cereals are high. Meat consumption has generally been modest and largely

supplied by less energy consuming poultry and pork. However, during the 1990s, there has been a shift towards consumption of more beef. While increasing income in North East Asia has been important, aggressive trade policy pressure by well-organized beef producer interests has also been a substantial factor. In the 1980s and 1990s, US pressure based on a strong domestic "beef lobby" was the predominant explanation of the opening of North East Asian consumer markets for beef imports. However, the rise of the WTO as a vehicle for global market opening has also increased the leverage of other producer countries, most importantly Australia and Brazil, with its strong and well-organized producer groups. Thus, when analyzing increasing beef consumption in North East Asia, the political economy perspective gives a substantial contribution to understanding the "westernization" of consumption patterns. As this consumption shift is destructive both for local producer environments and global energy consumption for food, it provides support for the argument that current global trade efforts often favor strong producer interests at the expense of wider concerns for environmental sustainability (Kasa, 2005).

This increase in international trade is frequently attributed to three factors; (1) trade liberalization, (2) improved technology – particularly in transportation (e.g.,

containerization and sea-land, roll-on, roll-off modes) and communications, and (3) the low cost of labor in developing nations, made accessible by both trade liberalization and the new technologies (Dicken, 2005; Curtis, 2009).

The formation of NAFTA led many U.S. manufacturing firms to relocate production to Mexico to take advantage of lower labor costs. When China joined the WTO in 2001, some of those firms relocated there to get the benefit of even cheaper labor despite a very large increase in transportation miles (Jordan, 2008; Curtis, 2009).

Cost efficient, rapid and predictable transportation is a prerequisite for the exploitation of cheap labor at the end of this long-distance global trade. These supply chains and international division of labor are put at risk by global warming and peak oil. (Curtis, 2009).

Anthropogenic climate change results from emissions of greenhouse gases beyond their temperature neutral absorption. Due primarily to human consumption of fossil fuels, global warming is predicted to have physical impacts relevant to global trade flows (Curtis, 2009). With respect to food trade and transport food miles is an emerging issue for consideration brought about by globalization with immense implication to global climate change.

Food miles

Food miles is a term which refers to the distance food is transported from the time of its production until it reaches the consumer. Food miles are one factor used when assessing the environmental impact of food, including the impact on global warming. The distance products travel from farms to end consumers is 25% father in 2007 than it was in 1980. Some scholars believe that the increase is due to the globalization of trade; the focus of food supply bases into fewer, larger districts; drastic changes in delivery patterns; the increase in processed and packaged foods; and making fewer trips to the supermarket. The concept of food miles is part of the broader issue of sustainability which deals with a large range of environmental issues, including local food (MacGregor et al., 2006).

According to the Ministry of Agriculture, Forestry and Fishery, Japan's food miles is relatively larger than other developed countries. The amount per person is the top among the developed countries. This is due to the distance of delivery which is significantly longer than other countries.

Table 1.1: Food Miles

Country	The total food miles amount	Food miles per one person
Japan	90 billion	7093
South Korea	31 billion	6637
USA	29billion	1051
United Kingdom	18billion	3195
Germany	17billion	2090

Unit: ton x km

Source: Ministry of Agriculture, Forestry and Fisheries, 2009

1.3 Significance of Study

This study is significant due to the fact that globally and especially for Japan food production resources are limited. Overusing the land for food production may lead to destruction of our ecosystem due to excessive farming activities. That is why this study will be beneficial for understanding the gravity of the food waste situation in the country, and be useful for formulating appropriate policies to minimize waste and promote sustainable food management to ensure a better environment for all. This study is useful for averting food crisis in the face of deteriorating environment and the threats of climate change. In a

way, food wastes can be considered a serious environmental problem and a contributing factor to climate change. Moreover, the findings of this study will provide inputs to policy making in the light of the current insufficient domestic food supply in Japan.

1.3.1 Climate change and food security

The unimpeded growth of greenhouse gas emissions is raising the earth's temperature. The consequences include melting glaciers, more precipitation, more and more extreme weather events, and shifting seasons. The accelerating pace of climate change, combined with global population and income growth, threatens food security everywhere. Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. Although there will be gains in some crops in some regions of the world, the overall impacts of climate change on agriculture are expected to be negative, threatening global food security (Nelson, et al., 2009).

For instance, most of the food wasted by United Kingdom households or close to 6 million tons are used for landfill. The environmental impact of this

disposal is high: every kilo or ton of food generates the equivalent of about 4.5 times that amount of carbon dioxide. Altogether, it is estimated that some 18 million tons of CO_2 are generated in the United Kingdom from food that could have been eaten but that is thrown away. Food losses and wastage must be reduced. But there is need to better understand what true loss is and what may appear to be losses. This is important in order to distinguish losses from the use and reuse of part of the food (Lundqvist et al., 2008).

At the present, there are no reliable means of tracking plant pests and diseases globally. So we lose 40% of what we grow to pest and diseases damage to crops in the field, in transit and during storage. This threat is set to increase as trade flows and climate change accelerate the movement of plant pests and pathogens. By losing less, we can feed more people right now-without extra land, water, energy or chemicals, or creating new crop varieties. Using data and information that already exist, knowledge bank to reduce losses in all major food and cash crops could be up and running within three years (Nicholls, 2010).

1.3.2 Food consumption and environment

Food waste happens at every stage of food chain. In fact, everyone is guilty of it. The Next Generation Food (2009) previously reported that food

wasted by Europe and the US could feed the world three times over. An estimated 8.3 million tons of annual household food waste is produced in United Kingdom, most of which was edible. The vast majority of the people already know throwing away good food is a dreadful waste, and that there are some associated environmental implications to consider as well. The amount of food thrown away actually wasted resources. Consider all the energy, water and packaging used in food production, transportation and storage. All these are wasted whenever perfectly good foods are thrown away. Stopping edible food wastage means avoiding the CO_2 impact equivalent to that of taking four cars off the road (Next Generation Food, 2010).

Food waste contributes to excess consumption of freshwater and fossil fuels which, along with methane and CO_2 emissions from decomposing food, impact global climate change. US per capita food waste has progressively increased by ~50% since 1974 reaching more than 1400 kcal per person per day or 150 trillion kcal per year. Food waste now accounts for more than one quarter of the total freshwater consumption and ~300 million barrels of oil per year (Hall et al., 2009). Every ton of food waste prevented has the potential to save an equivalent of 4.2 tons of CO_2. The study funded by the National Institute of

Diabetes and Digestive and Kidney Diseases shows the progressive increase of food waste in America and its environmental Impact, and it was found that 40 percent of all the food produced in the US is wasted (Next Generation Food , 2010). The United States spends about 1 billion dollars a year just to dispose wasted food. Over 12 percent of the total municipal solid waste generated in American households was food scraps and less than three recovered. The rest was thrown away and disposed in landfills or combusted in incinerators (Society of St. Andrew, 2010).

According to the life-cycle assessment, food products rank among the five most resource-demanding and polluting product groups in Sweden. For other countries similar results are obtained. Different studies about energy use indicate that food is the second most energy demanding group after housing (Engstrom, 2004).

1.3.3 Food insufficiency issue in Japan

The Figure 1.2 indicates two types of the calculations for self-sufficient rate. The blue dot line is the self-sufficient rate based on calories. The blue line is the sufficient rate based on production value : domestic supply calories per person a day (1012 kcal) /total supply calories per person a day (2473 kcal) X 100 = 41%

(Year of 2009) .This figure shows that the sufficient rate was 73% at 1965, however the sufficient rate decline to about 40% in 2008 (Tomo, 2010)

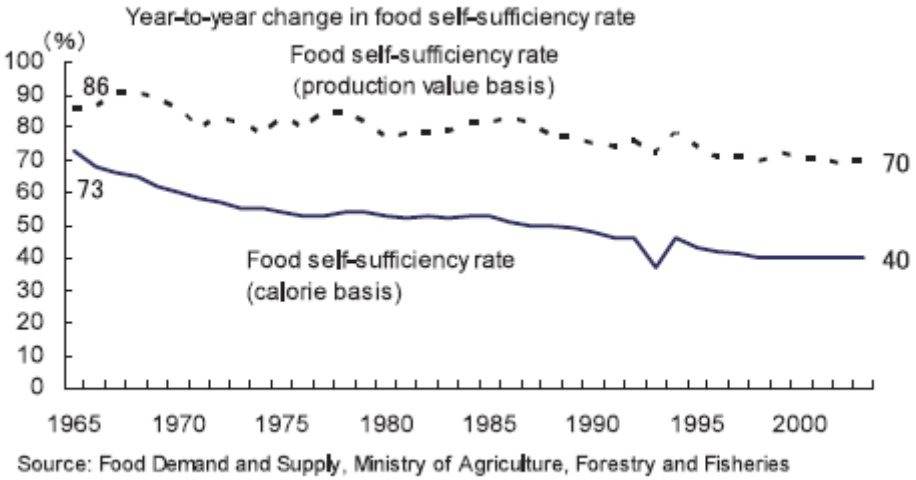


Figure 1.2: Self Sufficiency rates Calculated by Several Methods

Source: MAFF, 2010

There are three factors indicating the reasons why Japan has a lower self-sufficient rate. First one is to fill the gap between import and export. Japan was getting export surplus by automobile manufacture products, so Japan started to import a lot of agriculture products from other countries. Second reasons is because Japanese income became high and Japanese started to eat more livestock rather than rice, so import a lot of feed such as corn soybean for livestock. The

third reason is Japanese eating habit changed. “Westernize” and “eat out” become popular, because of liberalization of foreign exchange and at 1985 the Praza Agreement, yen become strong, and the food services use cheaper imported products (Sudou et al., 2010).

1.4 Definitions of Key Words

Food loss is defined as the food waste which can be still edible. Waste Resources Action Programme (WRAP) in 2008 provides various categories of food wastes into distinct categories following:

- **avoidable waste:** food items that could have been eaten if they had not been allowed to go off, had not been past their food date or had been wanted;
- **possible avoidable waste:** food that could be eaten but which some individuals choose not to eat, e.g. bread crusts, meat rinds and soft vegetable and fruit skins.

- **unavoidable waste or inedible wastes:** food that could not have been eaten and includes items such as teabags, bones and hard fruit and vegetable peel.

As defined by the Food loss in this study includes both avoidable and possible avoidable waste.

Food expiry recommendations are divided into two categories according to MAFF(2009) which are:

Use-by: the period where it is safe to eat. Never eat the items after this specified date and be careful about storage following the label's instruction. This date can be seen on deli such as lunch boxes, sandwiches, pastries.

Best before: The period where food is at its freshest and safe for eating. It doesn't mean one cannot eat the items after this date. One can still eat the items based on personal choice and judgment. It is considered to be safe to eat the food products after the "best before" date, but the quality of the food product may no longer be high

1.5 Research Questions

1. Who decides food expiration date and how is it decided?
2. How much food waste is being disposed in Oita-prefecture?
3. How much food waste is being recycled in Oita-prefecture?
4. How much food is lost in households?
5. Do the households try to reduce the losses, and what strategies are used for this?
6. What is the households' perception about expiration date and food waste?
7. What is the shopping behavior of Oita households?

1.6 Primary Research Objective

The above research objectives will be achieved through the research objectives described below. The followings are the objectives of this study:

1. Describe the nature and extent of food losses among households in Oita, Japan
2. Describe the existing policies related to the food losses.

3. Describe the household food management practices in Oita in Japan.
4. Analyze the types, volume and cost of food losses being disposed.
5. Identify the environmental implications of food losses.
6. Analyze the households' behaviors and opinions about food losses.
7. Recommend measures or strategies for the policy and food losses in Oita prefecture.

1.7 Methods of Research

This research employs both qualitative and quantitative research designs. This research uses primary and secondary data. The primary data was collected from respondents through surveys, interview and direct observations. Case studies of selected households were also conducted. Secondary data was also collected from varied sources including official documents from Oita City and official survey reports from the United States and United Kingdom. The following are the research activities undertaken:

1) Survey profile and policy for food waste management and food losses of Oita-city were analyzed from the data collected from the

several municipal offices. Data on population, the number of, the amount of food waste for one year, and what kind of disposal system they use was collected.

2) Data was collected by observing food losses in147 households, situated in Oita, Beppu, Saiki ,Kunisaki, Kitsuki, Yufu, Usuki, cities, and Hiji mathi in Oita Prefecture. The study period during Aug. 15 August to 15 September, 2010.The aim of this survey is to know the volume of households' food wastes per week, and what kind of food they tend to waste and what are the reasons.

3) More in-depth case studies on four individuals were conducted. The data includes the actual purchased food and reasons for buying and the pattern of people's shopping behavior.

4) Existing data about USA and United Kingdom about food waste losses were compared with Japan, and also with Oita's data for checking the differences and similarities.

5) Documentation of 16 practices was done for one-week to determine what food individuals buy, eat and throw away.

6) Questionnaires on expired food and willingness to pay were administered in APU cafeteria to determine Ritusmeikan Asia Pacific University students, staff, faculty, and guests' opinions regarding food expiry dates.

7) Secondary data were collected from published and unpublished sources such as internet, newspapers and journals. These data were used to analyze expired food products, and to identify the authorities deciding food expiry date in Japan. The data about approaches to lowering food losses of other prefectures and any problems related to lowering food losses were also collected. These data gave ideas on how to reduce food losses as much as possible.

1.8 Scope and Limitations

The study was conducted in limited time and small sample of people in Oita City. The survey was distributed to people living in Oita City. However, some people did not want to cooperate in the conduct of study so the actual number of returned questionnaires is limited. There are only 4 case studies and 16

documentations for one week period due to the limited time. This survey was conducted only during summer, so that differences in seasonal eating habits were not considered in the study. Also, the respondents are not willing to give information about income.

Chapter 2

Literature Review

2.1 Introduction

This section highlights the concepts and studies related to food consumption, consumption behavior, food loss, food security and safety. The review guided the design of questionnaires, collection of relevant data and the interpretation and analysis of findings.

2.2 Food Security and Safety

Food security and safety are the two paramount concerns of food consumption. The study attempts to determine the influence of these two concerns on food losses.

2.2.1 Food security

The achievement of food security is defined as: “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”, taken from the World Food Summit of 1996 defined food security

(World Health Organization, 2010). This implies that sufficient food indicates a food security among the population. However, there are about 960 million hungry people worldwide; an increase of more than 100 million during the last 10 years is seen.

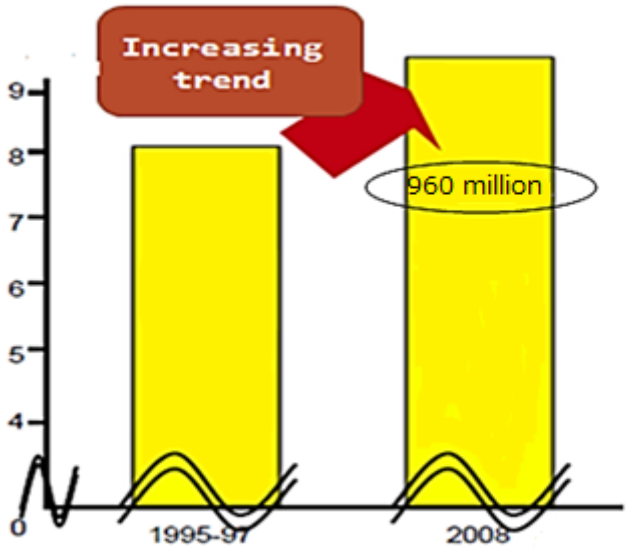


Figure 2.1: The State of Food Insecurity in the World

Source: MAFF

Food security is the availability and access to food, the accessibility may be limited at any point with an individual or a household or a global level (Pinstrup-Anderson et al., 1995). At the national level (Mellanby, 1975) published

a book entitled "Can Britain Feed Itself?" explores the capacity of the agricultural industry in Great Britain to produce sufficient food to support its population. Various recommendations were made about the methods of agricultural production, land use patterns and diet changes in people. These recommendations are mainly to maximize the self-sufficiency of the country. Several studies on land use patterns have, at regional and global levels, calculated the ability of various regions to feed their populations under future situations (Penning et al., 1995; WRR, 1995). The studies are founded on a belief that food security of individuals will increase rather than at a global level through regional independence in terms of food production and consumption (Conwell et al., 2003).

Food security is considered as a complex sustainable development issue, which is associated to malnutrition and other health related issues. It is also related to larger global issues sustainable economic development, environment, and trade among them. The Food security concept causes a great deal of debate creating a lot of discussions. Here are examples of questions and issues raised:

- Although, sufficient food is available to feed everyone properly, is there a problem with distribution management?

- Can future food requirements be met with current levels of production or not?
- Is it necessary to have national food security when there is global free trade for food products as well?
- Will globalization lead to the persistence of food insecurity and poverty in rural areas?

2.2.2 Food safety

Food is very essential for our daily life, but there is a lot of uncertainty due to reducing food safety and there is no "absolute guarantees" that there would be sufficient for all. Often the food we consume may contain not only nutrients but also agents that may be hazardous to our health and may cause problems. This section covers issues related to quality and management of food production, issues about food labels, dietary habits and manufactured and expiry date of the food products.

Fujiya Co. in January 2007 admitted to intentionally using expired ingredients in making of many of their confections (Siebert, 2009). 2007 Quality control implementations are very significant for food product production. The two

major downfalls of Fujiya Co. are the lack of quality control and effective management. The major fault of the management within a company is the lack of shared information which leads to some problems (Siebert, 2009). Maintenance of food quality is very important for a large company to uphold its corporate image as the media covers most incidents around the globe and it is aired for all to know. A small mistake like the one committed by Fujiya Co. made as in the case of using old milk in cream puffs, can lead media to uncovering other scandals. The problem can reflect on both the decision makers as well as the scandal itself in terms of creating a bad impression on food safety. Ensuring quality to the customers through clean production and proper management is necessary to keep customers coming back for more and this is what was lacking in the case of Fujiya Co. (Siebert, 2009).

Consumption among people is varied and keeps changing according to situations and other externalities. The dietary habits of the Japanese people have changed considerably in the last few decades. Japan has started to import enormous amounts of food products to from overseas. To respond to these changes in situation and the public concerns, the Food Safety Basic Law was

enacted in 2003. It was determined to develop new administration for ensuring the safety of food. The aim and priority of this law is to protect the health of general public in Japan. This law illuminates the responsibilities of the state, local governments and food related industries businesses from production to marketing (processing, wholesale, and retail). It also makes the roles of consumers clear. In addition, by initiating a new concept of “risk analysis”, this law also aims to amply promote the guarantee of food safety (Food Safety Commission, 2008).

Food labels give us information so that we can choose the right food product with the right ingredients, but sometimes it can be confusing. There are some rules that every food manufacturer must follow. These rules protect us from false claims or misleading descriptions or information about the food product. These rules indicate clear guidelines on what labels can and cannot show.

2.3 Consumption (Food Habits)

2.3.1 Wasteful consumption

The Basic Law of Japan defines *Shokuiku* as the acquisition of knowledge about food and the capacity choose the right kind of food substances (Ministry of Agriculture, Forestry and Fisheries, 2010).

Despite the low food self-sufficiency, enormous amounts of leftovers and expired products are wasted in the food-related industries or at homes, even in situations of food satiation. In fact, the excess of per-capita calorie supply over actual consumed calories is steadily rising. This in-turn raises the issues of wasting resources and inducing negative environmental effects (Ministry of Agriculture, Forestry and Fisheries, 2010) (see Figure 2.2).

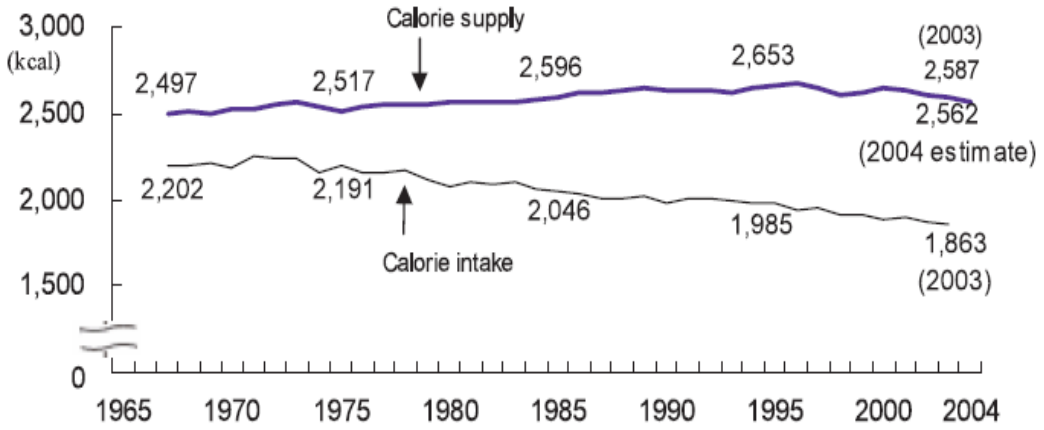


Figure 2.2: Amount of Food Supply and Calorie intake in Japan

Source: MAFF and MHLW

Tremendous quantities of food are wasted after production and discarded during processing, while transporting them, at supermarkets and the kitchens. More than enough nutritious food is being produced to feed the global population. Distribution and access to food is the major problem and hence, many people are hungry, while at the same time many of them overeat. Food is used to take care of not only the necessity to feed hunger but also our wasteful habits (Stockholm International Water Institute, 2008).

Lundqvist in 2008 mentioned "Generally, the kinds of food losses in developed countries are referred to as wastage, i.e. food is discarded even if it is perfectly good to eat. If the discarded food is used for landfills rather that properly

disposing it, or in composts or for biogas production, the organic content will generate gases, including methane, which is a very potent greenhouse gas. More importantly, the public understanding of the magnitude and the consequences of the food waste is poor. According to studies conducted by wrap, the majority of people in the United Kingdom describe the amount of food they throw away as: "some, a little, hardly any or none", as compared to the actual waste that are equivalent to about a third of the food bought, most of which could have been eaten. The total worth of the wasted food would be more than 10 billion pounds in retail value (about 14 billion USD). Moreover, the consumers are not familiar with the greenhouse gas emissions that are generated both in connection with growing food transport, food processing and food storage" (Lundqvis et al, 2008).

2.3.2 Food losses (Food waste)

The losses occurring due to food wastage is known as food losses (Ushikubo, 2009). In recent years, increasing concern about hunger, resource conservation and environmental and economic costs associated with food waste have raised public awareness of food loss. Nevertheless, large quantities of edible food products are lost at every stage of the marketing system. Even a modest

increase in revival of such wholesome food products could diminish hunger. This can be achieved by supplementing existing food-assistance efforts; provide tax saving to farmers, supermarkets, and foodservice establishments that donate food; and lessen the environmental impacts of waste disposal. Understanding where and how much food is lost is an important step in reducing waste and increasing the efficiency of food recovery efforts. According to the (USDA)'s New Economic Research Service (NRS) estimators, about 96 billion pounds of food, or 27 percent of the 356 billion pounds of the edible food available for human consumption in the United States, were lost to human use at these three marketing stages in 1995. Fresh fruits and vegetables, fluid milk, grain products, and sweeteners (mostly sugar and high-fructose corn syrup) accounted for two-thirds of these losses.

Household food losses occur because of over preparation, preparation discard, plate waste, cooking losses, spoiled leftovers, and breakage, spillage, and package failure, either in the home or en route from the point of purchase. Moreover, household waste is generally lower for frequently purchased staple items like bread, milk, and cereal than for less frequently used specialty products such as sour cream, hot dog buns, or items bought on impulse. They also concluded that large quantities of single food items, entire heads of lettuce,

half-eaten boxes of crackers, and sprouted potatoes –rather than plate scraps – account for the largest share of household food loss (Kantor et al., 1997; Kantor et al, 1997).

Every day, the average American throws away about one and a half pounds of food. Slightly wilted lettuce, half-eaten cheeseburgers, bruised apples end up in the trash. It is better to buy and cook less food, and compost the rest. Although it doesn't sound like much, those one-and a half pounds add up to 31 million tons end in landfills or incinerators each year. That's roughly equivalent to the weight of 74 Golden Gate bridges. These dumps are not only unsightly; they produce 34% of the methane in the U.S. –a greenhouse gas more than 20 times as potent as carbon dioxide (USA TODAY, 2010).

In comparison, United Kingdom households waste 6.7 million tons of food every year, around one third of the 21.7 million tones we purchase. Most of this food waste is currently collected by local authorities. Some of this will be recycled but most is still going to landfill where it is liable to create methane, a powerful greenhouse gas. The remaining 800,000 tones is composted by people at home, fed to animals or tipped down the sink. Most of the food we throw away (4.1 million tones or 61%) is avoidable and could have been eaten if it had been

managed better (Waste & Resources Action Programme, 2008). Truly unavoidable food waste, like vegetable peels, meat carcasses and teabags, accounts for 1.3 million tons a year or 19 % of the total, with the remainder being "possible avoidable" food waste items such as bread crusts that some people choose not to eat and potato skins which can be eaten when food is prepared in certain ways but not in others (Waste & Resources Action Programme, 2008). Nearly half (46%) of the avoidable food we throw away is in a fresh, raw or minimally processed state, with an additional 27% thrown away having been cooked or prepared in some way and 20% ready to consume when purchased. Starchy food are most commonly thrown away after being prepared, with 45,000 tons of rice, 33,000 tons of pasta and 105,000 tons of potato thrown away each year, suggesting people prepare too much. Overall quarter of the avoidable food thrown away each year is thrown away still in its packaging, either opened or unopened.

Typically households waste more than they think they do and households that are adamant that they waste no food waste nearly 90 kg a year of avoidable food (Waste & Resources Action Programme, 2008).

Research has shown good intentions are often hampered by a range of factors including:

- A lack of planning when shopping for food and buying more than is needed;
- Poor food storage knowledge;
- A lack of confidence around cooking (especially making meals from the food available in the house, and portion control), and confusion over food date labels (such as the difference between "use by" and "best before") (Waste & Resources Action Programme, 2008).

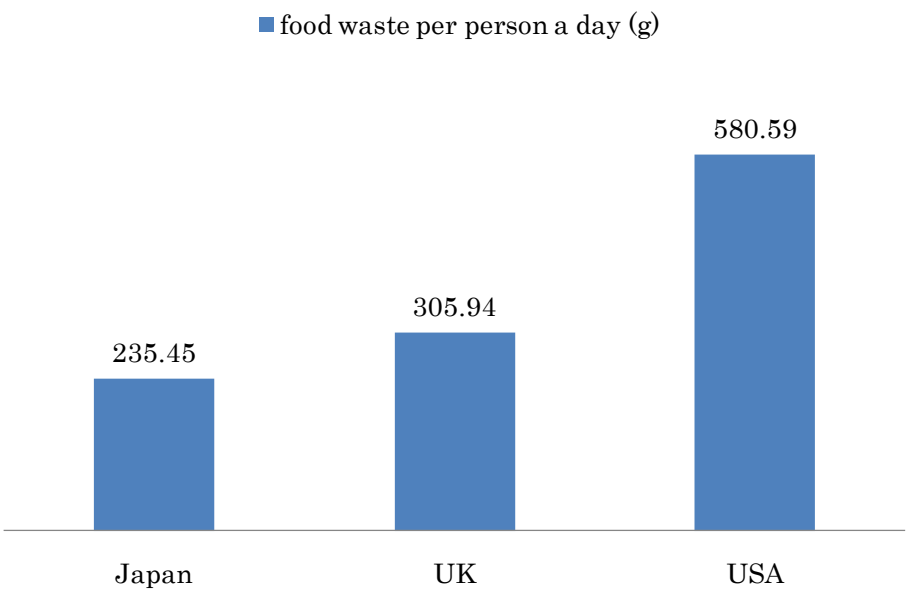


Figure 2.3: Food Waste per person a day (g)

Source: (Committee toward Food loss, 2008; Kantor et al., 1997; Waste & Resources Action Programme, 2008)

Presently in Japan, the current abundance of food is considered an ongoing thing as most people believe this situation will continue without change as they tend to forget the resources are limited. For food produced in Japan, there is a gap between the rural producers and the primarily urban consumers. Both of them do not think of the other. This is also the reason why gratitude is less for the food we get. It is very difficult for the consumers to know the difficulties faced by the producers and their efforts that go into producing the food. According to the Ministry of Agriculture, Forestry and Fisheries, the food wastes from households

are classified as the possibly avoidable waste such as excess removed peel, left over on the plate, and unpacked items which are not even cooked. When the survey was conducted, the reasons why throw away are that 55.4% said lose its freshness, and 41.0% is the out of date (Ushikubo, 2009).

2.3.3 Consumption behavior

Consumption and wastage go hand-in-hand in terms of utilization of food products. Some products may be consumed while others may be fully or partially wasted. It was found that people over 50 years old tend to throw away less food than younger age groups (Waste & Resources Action Programme). This result was obtained by interpreting the results of waste sorting analysis as well as looking at the results of interviews where more than 60% of interviewed people aged over 60 years said they never throw food away. A possible explanation for this correlation could be found through the study of a particular system of values of the so called “post war generation”, where saving and recycling were prominent and very vital. However, financial restrictions of retirees or the usually increasing amount of time spent at home might also be a factor of influence (Schneider, 2008).

Eco-cooking means acting in relation to the environment when you do something related to the meal every day. It is not just for cooking, but also in the time of shopping and the clean up. To adopt eco-cooking is considered as an endeavor to decrease or completely reduce food wastes' that have negative impacts on the environment (Hiroshima Prefecture Nutrition Organization, 2010).

The CO_2 produced by households due to cooking food is not a considerable amount compared to total societal emissions. However, household wastes mainly result from the food waste and plastic containers, which comprise f 30% of whole normal trash 52 million tons in a year from household domestic wastewater is the vegetable waste, seasoning, and heeltap of alcohol (Yamamoto, 2006).

Energy is also needed for all aspects of food processing including transportation, storage, and processing.. etc. All of these stages need energy. Eco-cooking considers all stages to reduce the waste. The specific strategies of eco-cooking are the following categories: shopping, cooking, and clean up times (Yamamoto, 2006).

2.3.4 Food wastes classification and handling

Consumption and wastage go hand-in-hand in terms of utilization of food products. Some products may be consumed while others may be fully or partially wasted. It was found that people over 50 years of age tend to throw away less food when compared to other younger age groups. This result was obtained by interpreting the current data through waste sorting analysis as well as looking at the results of interviews where more than 60% of respondents, aged over 60 years said they never throw food away. A possible explanation for this correlation could be found through the study of a particular system of values of the so called “post war generation”, where saving and recycling were prominent and very vital. However, financial restrictions of retirees or the usually increasing amount of time spent at home might also be a factor of influence (Schneider, 2008).

Figure 2.4 shows the classification of food waste. Food waste is categorized in the general waste and industrial waste. Moreover, the general waste can be two categories; one is household waste and the other is food service and

retailing industries waste. The food recycling law only conducted to the industrial waste and food service and retailing industries (Suzuki, 2008).

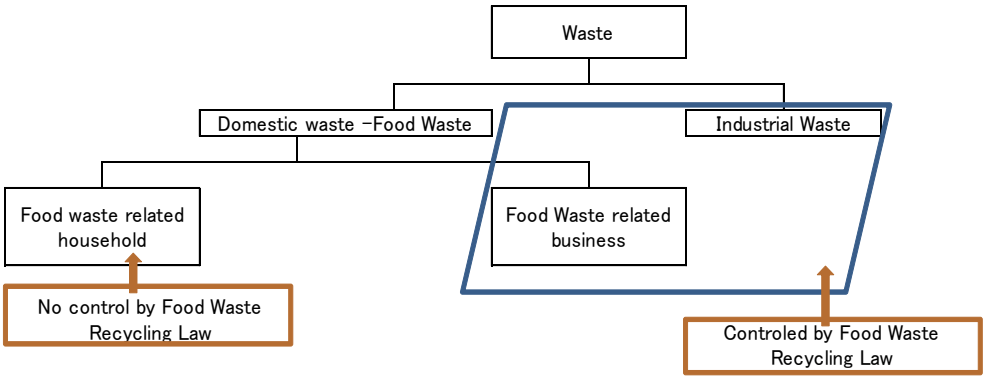


Figure 2.4: Classification of Food Waste

Source: Suzuki, 2008

Figure2.5 shows that 62%of food is discarded before the best before date and 8% is discarded within one week after the best before date.

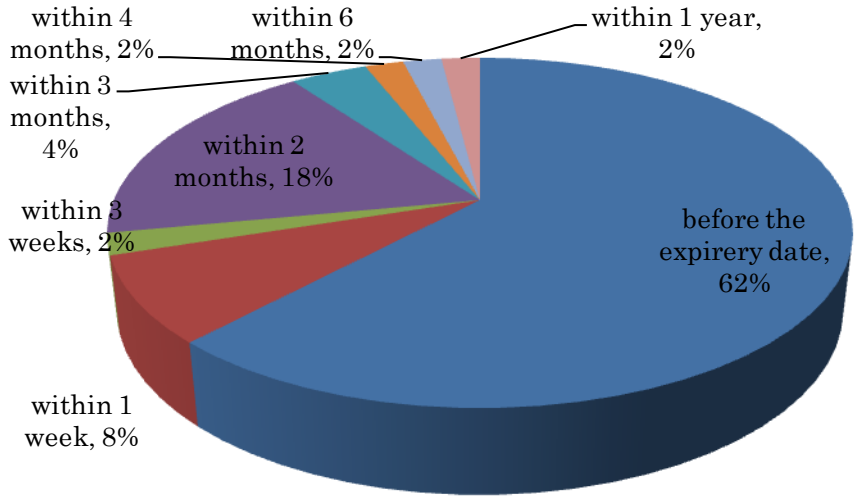


Figure 2.5: Thrown away Food without Unpacking with the "Best Before" Labeling

Source: Takatsuki, 2004

Figure 2.6 show that 21% of the total food waste is reused in some way either as fertilizer or livestock feed or other uses etc. where as 79% are burned or thrown into landfills. Interestingly, for industrial food waste, 78% of the food waste is reused whereas for household food waste, only 2% of the food waste is reused (Suzuki, 2008).

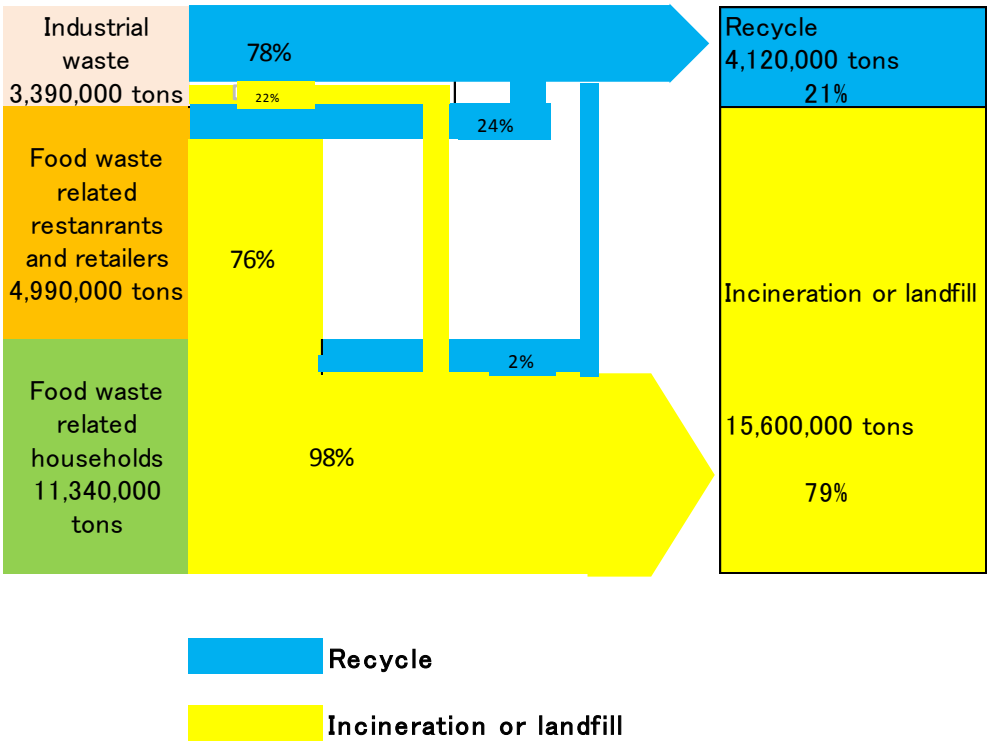


Figure 2.6: The Way of Dealing with Food Waste

Source: Suzuki, 2008

2.4 Summary

The concern for food security and safety influences the consumption behavior of households. The concern for food safety may compromise food security in the long term. Food safety consideration may lead to food losses or wastage as people may throw away food which can still be edible simply because

of expiration dates. People have different behavior with respect to both food safety and security. Food losses or wastes can be caused by consumption behavior and perception of impacts of food wastes to the environment. Classification and handing of food wastes are also important to minimize their environmental impacts. Based on this review the study explored the factors related to the nature, causes, handling and management of household food wastes in Oita City.

Chapter3

Methodology

3.1 Research Methods

Based on the literature review above, this thesis examines the causes and nature of food losses in Oita Prefecture. The study uses primary and secondary data from surveys, case study, document analysis, observation, and secondary data collection. In order to provide broader perspective, the results are compared with existing food waste management data from the USA and United Kingdom data. This section also includes the present policies, practices, and perception, and how much volume of food wastes were documented in Oita Prefecture, mainly Oita City.

3.2 Description/Profile of Oita Prefecture

Figure 3.1: Location of Oita Prefecture

Source: Japan National Tourism Organization, 2010

Ōita Prefecture is located on the north-eastern section of the island of Kyusyu. It is 119 kilometers from east to west, and 106 kilometers from north to south, with a total area of 6,339 square kilometers (Kobayashi, 2009). Total population is 1,196,795. The total population of males is 563,935 and the

population of females is 632,860. The total numbers of households are 489,944, recorded as of December 1, 2009. (Oita Prefecture web-site)

According to the Ministry Affairs and Communications (2008) statistic data, the ranking of population of Oita prefecture is 33rd among the 47 prefectures. However, the percentage of people who are 65 and over 65 is ranked 9th out of 48 prefectures in Japan Furthermore, the ranking of unemployment rate is 16th. While the number of kinder-garden pupils per 100,000 of 3 - 5 year old is ranked 2nd, the number of elementary schools are 6th, Junior high school is 10th, High school is 7th and lastly, however, the number of university per 100,000 is 30th. The price level is 22th and hence, it can be considered that the ranking is of the middle range. The individual income average is 33rd, but the household income is placed at the 12th position. The rate of job availability is 0.8 while it is ranked 23rd. According to the above mentioned data, there are individuals living in Oita during their school days or before university. These individuals may move to another prefecture for further studies such as university or to find work, as they find it difficult to live in Oita any longer. It is also important to note that, while a single individual's income is placed at the 33rd, the household income is placed at the 12th position. Hence, both

husband and wife have to work to support the family. These are some of the facts indicated through the primary and secondary data.

Table 3.1 indicates the population of each city for the survey, and the population in only Oita city central region makes up 38.22% of the whole prefecture. The numbers of food services are 2525 in 2006 (Oita city, 2006)

Table 3.1: Population of municipalities in Oita Prefecture

	Population	**A share of population among Oita prf.**	**Households**
Oita city	**462,317**	**38.22%**	**183,458**
Beppu city	**126,959**	**10.5%**	**55,108**
Saiki city	**80,297**	**6.64%**	**30,678**
Usuki city	**43,352**	**3.58%**	**15,490**
Yufu city	**35,386**	**2.93%**	**12,533**
Kunisaki city	**34,206**	**2.83%**	**13,588**
Kitsuki city	**33,567**	**2.78%**	**15,490**
Hiji machi	**27,640**	**2.29%**	**10,124**

Source: 地価・人口統計局　**2007**

3.3 Data Collection and Research Design

Households in Oita prefecture are the target for study. Figure 3.2 shows the activities and procedural flow of the study.

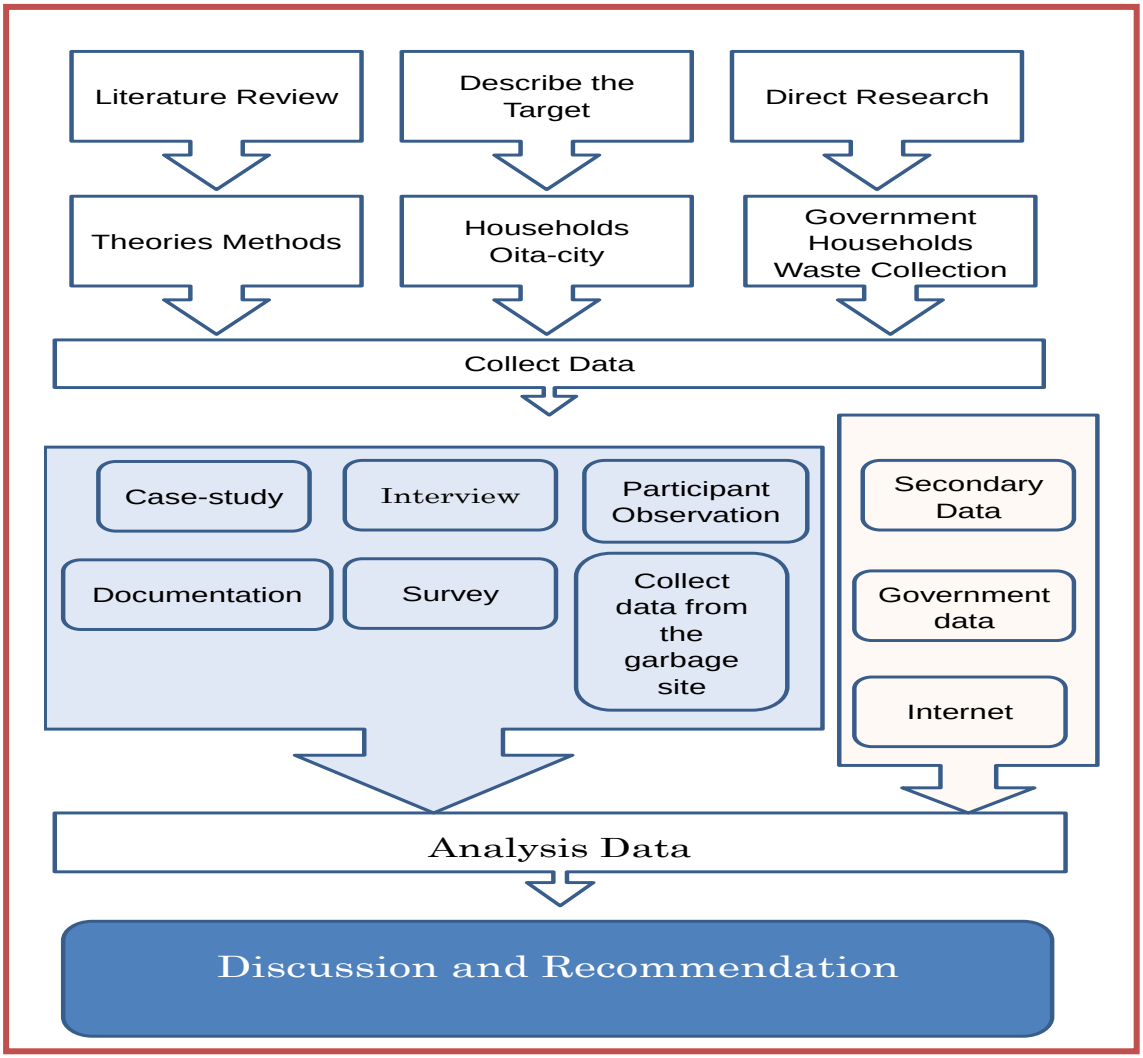


Figure 3.2: Process Framework of Study

3.3.1 Primary study of shopping patterns and behavior study (Survey)

This study is significant because the food losses from households in Japan are bigger than total amount of food waste from Industries and restaurants

and retailers. To reduce food waste losses, the behavior of consumers is studied. Secondly, it examines which types of food wastes people tend to throw away and those which are not thrown away. Shopping and consuming behavior of consumers is also needed.

This survey was conducted in Oita prefecture between 15 August and 15 September 2010. In total, 147 household responses were collected out of 151 from places including Oita-city, Beppu-city, Saiki-city, Usuki-city, Yufu-city, Kitsuki-city, Kunisaki-city, Hiji machi.

Figure 3.3: Oita Prefecture

Source: ZENRIN DataCom CO., LTD., 2011

This questionnaire was consisted of mainly closed questions, but each question also included space for open ended comments to allow for other answers. The questionnaire consisted of four parts.

1 Respondents profile 7 questions (Sex, age, occupation, education, , income, resident district, family composition)

2 Respondents shopping pattern (10 questions)

3 Respondents food waste (4 questions)

4 Respondents awareness for environment (1 question)

These questions were written in order to determine what factors affect them to throw away strongly, and their environmental awareness opinion related waste as defined by the research objectives in the first chapter.

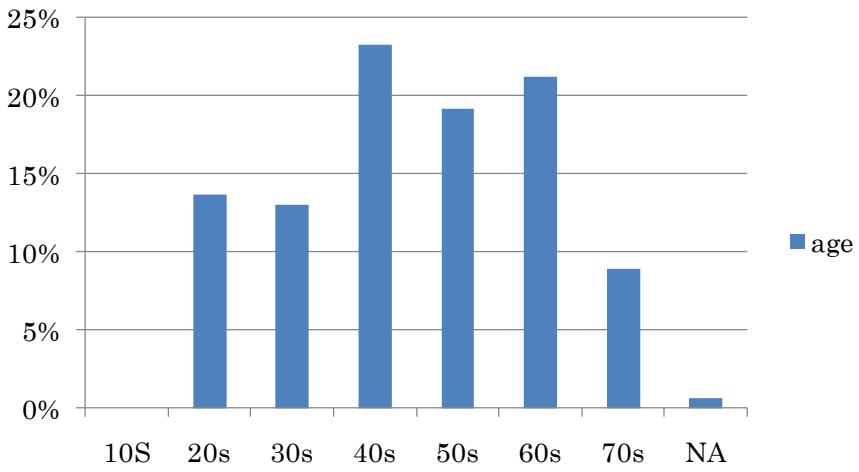
A. Profile of respondents

Before analyzing people's shopping behavior and their food related environmental opinions, description of the profile of the respondents including what age, and their educational level, gender, and occupation was done. The following shows the profile and other relevant information about the respondents in this study.

One-hundred thirty-two (132) are female among 147 respondents, and their ages are from 20s to 70s. Fifty (50) are housewives and 48 are office workers. Over 80% is educated with high school education or more.

Table 3.2: Number of respondents by gender

Male	Female	Total
15	132	147



N=147

Figure 3.4: Age of respondents

Table 3.3: Number of respondents by age

Age	Number of responses
20s	20
30s	19
40s	34
50s	29
60s	31
Over 70	13
No answer	1
Total	147

Table 3.4: Number of Respondents by Occupation

HW	OW	PS	PT	SE	PE	UE	OT	NA	Total
50	48	6	4	13	17	3	1	5	147

HW: Housewife **OW: office worker** **PS: public servant**

PT: part-time **SE: self-employee** **PE: live on pension**

UE: unemployment **OT: other** **NA: no answer**

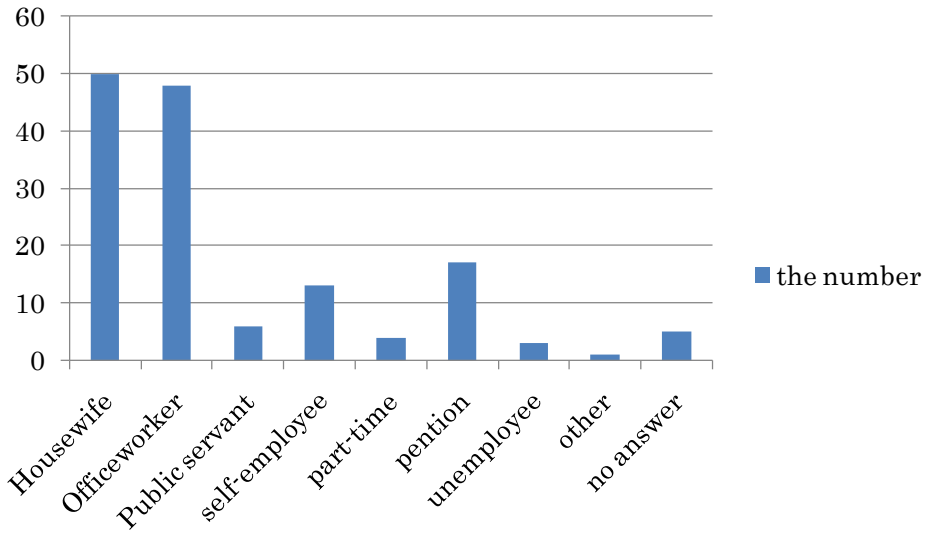


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Figure 3.5: Respondents' Occupation

Most of respondents are housewife and office worker, and 80% of the respondents graduated from high school and undergraduate level. Therefore, most of respondents have high school education and higher.

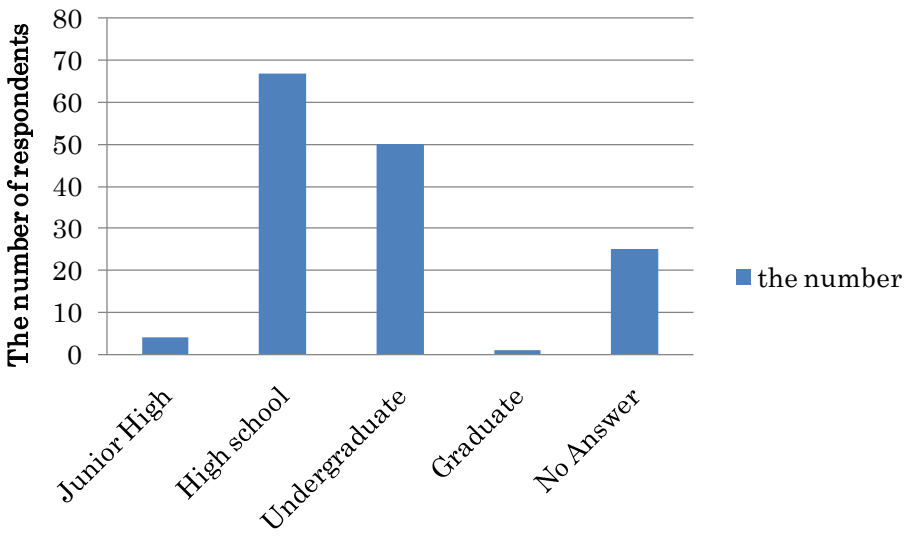

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Figure 3.6: Respondents' Educational Attainment

Culturally, the Japanese tend not to tell their actual income during surveys or interview as shown in Figure 3.6 It is therefore difficult to ascertain the income profile of the respondents.

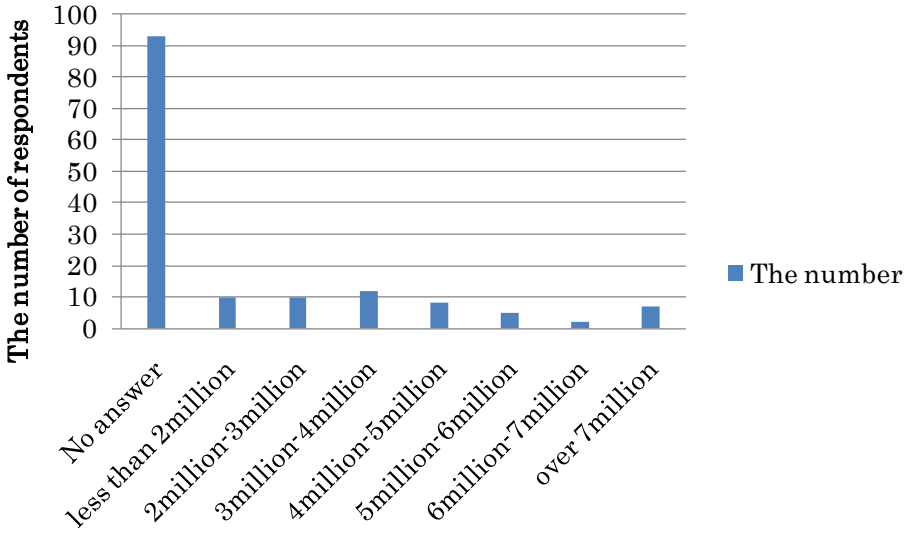

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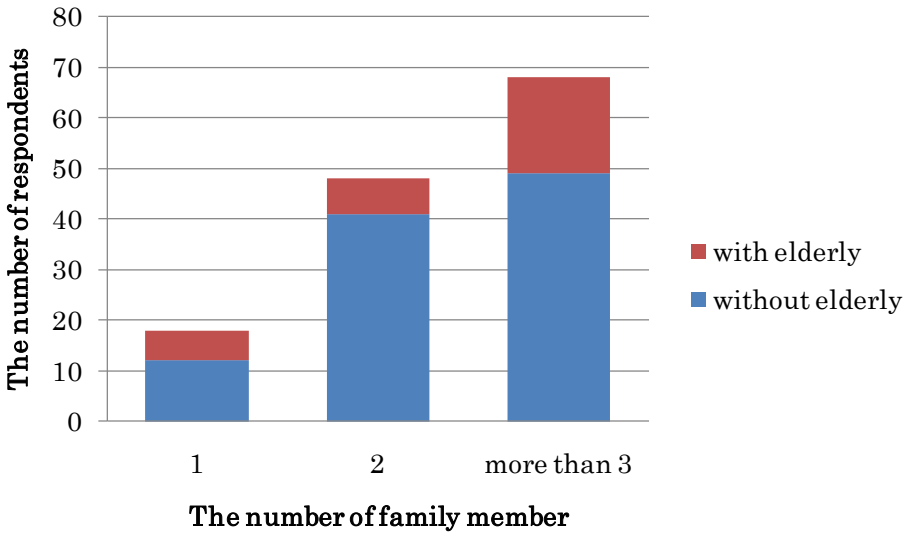
Figure 3.7: Respondents' Income Level

B. Family composition

Family composition and their ages are important in determining food consumption and waste behavior. In this study, age was categorized as 20s, 30s, 40s, 50s, 60s, 70s, and higher. Seniors are those over 70 years old. Figure 3.7 shows that, the senior members in each household, 70 years old and higher person live with other people.



N=147

Figure 3.8: Respondents' Family Composition

3.3.2 Case study of shopping behavior

Among the 147 respondents, four individuals were selected and observed with respect to their shopping behavior (profiles are shown in Table 3.4). The researcher observed their shopping behavior for food for one day. The researcher took pictures and interviewed the selected individuals as to their choice of store, food, shopping, cooking, waste patterns, and level of environmental awareness. The observation method was useful for documenting consumers' actual shopping behavior.

Table 3.5: The Profiles of Four Respondents

person	**Profile**
A	Age: 30s. Household composition: Father, mother and the individual. Occupation: Teacher. A's father is self-employed and Mother is housewife. Single
B	Age: 30s. Household composition: Father, mother and the individual. Occupation: Public servant. The father is self-employed and Mother is housewife. Single.
C	Age: 30s. Household composition: Mother-in law, husband and she. Occupation: Public servant. Her husband is an office worker. Her mother-in-law is retired person. Married.
D	Age: 40s. Household composition: Husband and she. Occupation: Self-employee and husband is office worker. Married.

3.3.3 One week documentation on food losses

Documentation was done by 5 households for one week. The following items and activities were noted:

1 Shopped items during one week (record weight if possible)

2 Items thrown away among shopped items during the week (Wight)

3 Menu of each meal and left over percentage if they produce (percentage)

4 Items remained after one week among shopped items during the week (Weight)

5 Items thrown away among storage items except the week shopping (Weight)

The respondents were requested to record all items being thrown away and the volume of discarded food as much as they can during the one week period. Weighing of leftover foods was difficult and tedious, so estimates were given instead.

3.3.4 Observation of food wastes in garbage

During the collection day of burnable garbage, the edible food in each garbage bag in one apartment was examined. The food items were described and

each item was weighed in each bag. This observation was useful to check the actual amount of waste compared to what respondents indicated in the survey.

Food wastes were categorized as grain, vegetable fruit, meat, egg, daily products, sea food, processed food beverage, and others. (see Appendix D) The bags were counted, opened and each item was weighed according to the categories. Data collection was done daily for one week.

3.3.5 Attitude survey in APU

In addition to actual food waste observations, a survey was conducted in Spring semester of 2009 in APU campus. This survey was conducted to determine how much people are willing to pay for onigiri (rice ball) in convenience store if those items are close to or after the expiry date. This was done to determine respondents' opinions regarding food expiry date and discount. The survey was conducted on July 20th, 2009 at APU cafeteria for 49 respondents.

3.3.6 Environmental implication calculation

Documents such as the MAFF Amount of Food Supply and the "USA: The Impact of Food Waste on Climate Change" were used to describe, calculate

food wastes, and to calculate the amount of carbon dioxide produced yearly from food wastes.

Chapter 4

Findings and Discussions

4.1 Introduction

This chapter describes existing policies related to food safety and food wastes. Analysis of collected data such as survey, case study, documentation, observations was done primarily for Oita City with data coming from other cities in Oita prefecture.

4.2 National Policy

There are four laws related to food losses. These laws can be categorized in terms of food safety, health, and food recycling. The Japanese Agriculture Standard Law is categorized as food safety law; these laws control the food safety. JAS law checks food ingredient and origin of foods whether it good for consumers.

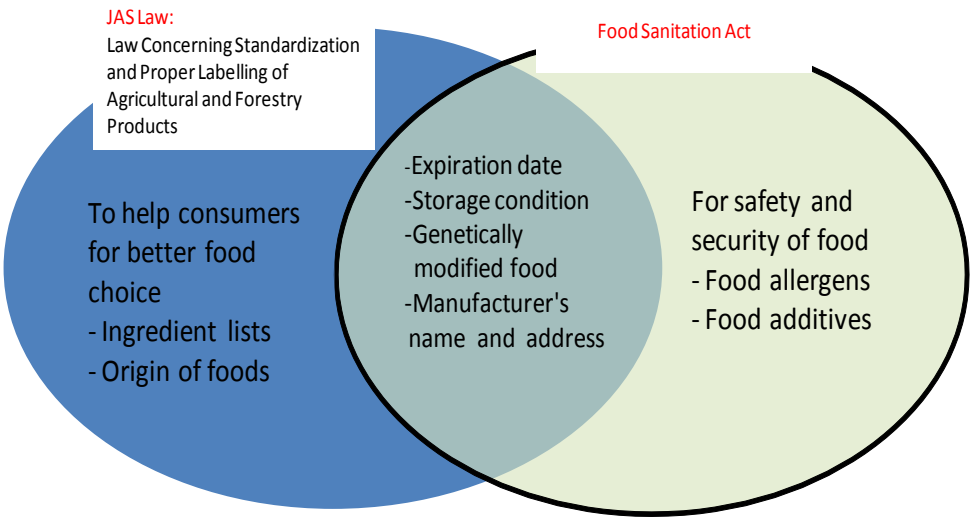


Figure 4.1: Relationships among JAS Law and Food Sanitation Act

Source: Consumer Affair Agency, 2010

Japanese Agriculture Standard Law (JAS Law)

The Japanese Agricultural Standard law (JAS law) was introduced in 1950 by the Ministry of Agriculture, Forestry and Fisheries for the purpose of standardizing food quality in the manufacturing industry. Since its introduction, it has undergone some revisions including the addition of quality labeling standard system. Presently the JAS law consists of two sections namely; the JAS Standard System and the Quality Labeling Standard System. JAS law is important for consideration in this study because it can influence marketing strategies of shops and consumer behavior.

The types of JAS Standards under the JAS Law include standards for grade, composition and performance, method of production, and expiry dates. Grading is a judgment that a product complies with relevant JAS Standard. Products graded as such are qualified to carry the JAS mark. Adoption of the JAS standards is voluntary, meaning that whether or not to undergo grading is left to choices of producers and other operators, and products without the JAS mark are able to be distributed without any restrictions. However, manufactures who do not adopt JAS standards may incur marketing challenges because retailers and consumers will not trust their products. Hence the majority of Japanese manufacturers dealing with agro-products are using JAS standards. Certified Operators under the JAS Law can use the JAS marks shown in Figure 4.2. While JAS standards are important for maintaining the quality of Japanese agro-products, and maintaining consumer trust, this same law through its expiry dates standards has the potential to influence food loss as consumers throw away food close to expiry dates.

Figure 4.2: Certified Operators under the JAS Law can use the JAS marks

Source: Ministry of Agriculture, Forestry and Fisheries, 2006

The Quality Labeling Standard System provides more detailed guidelines than the JAS Standard System so as to give consumers with accurate information for informed choices as necessary. For all food items, name and place of origin must be shown for fishery products. In addition to name and place of origin, labeling also shows if food is defrosted and/or cultivated. For brown rice and milled rice, the information must include: weight of contents; sate of rice milling, name or trade name, address and telephone number of distributor. All labeling items must be displayed on easily visible parts of containers or packages, in a close proximity to the products or in other places readily visible to consumers. Figure 4.3 shows some examples of the Quality Labeling Standard System. Food labeling is subject to the Food Sanitation Law which deals with the issue of expiry dates.

Figure 4.3: Example of Quality Labeling Standard System

Source: Ministry of Agriculture, Forestry and Fisheries, 2010

Food Sanitation Act

CAA requires that "safety and security of food, food allergens and food additives are checked". This act was established by Ministry of Health, Labor and Welfare (MHLW). Now Both Jas law and Food Sanitation Act is controlled by the Consumer Affairs Agency of Japan (CAA) which is external Organization of the Cabinet Office Both JAS and Food Sanitation Act checks the expiry date, storage condition, genetically modified food products, and manufacturer's name and address. (The Consumer Affairs Agency of Japan Food Labelling Division, 2010)

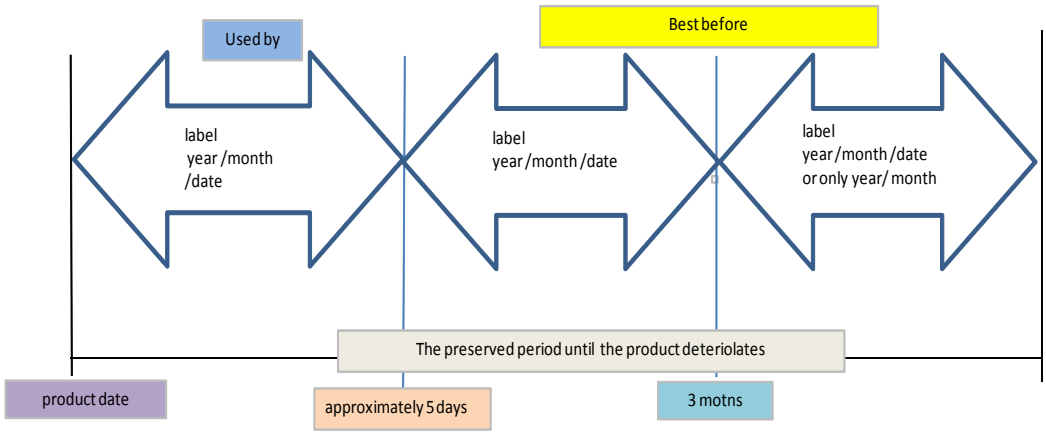


Figure 4.4: Differences between "Used by" and "Best before" expiry dates

Source: Toyama, 2007

Food Recycling Laws

This law is one of several recycling laws enacted between 2000 and 2001 in response to the concerns over the limited capacity of the nation's garbage dumps. (Shimizu, 2003)

1. A food-related business that generates more than 100 tons of food waste a year is obliged to submit an annual report, on how it manages this waste, to the relevant Ministers.
2. A food-related business can collect and transport food recycling resources without the permission required under the current Waste Management Law if the business prepares a closed-loop recycling plan and receives approval from the relevant Minister. In such situations, food-related

businesses are to use agricultural, livestock and aquaculture products that are raised using waste-derived fertilizers or feed.

3. Food waste can be used for thermal recovery when recovery when recycling is not feasible.

Under the current Food Recycling Law that was enacted in 2000, all food-related businesses, especially food manufacturers, retailers and restaurants that annually generate more than 100 tons of food waste, are required to reduce their wastes at least 20 percent, for example by recycling it into fertilizer or feeds. (Japan for Sustainability (JFS) non-profit organization, 2007).

Under this recycling law, households are not obliged to recycle their waste, while other recycling laws such as Home Electric Appliance Recycling Law targets households. As the law is unknown among households, the total household's food waste is larger than that of industries or businesses. Therefore, this law is hardly known to households, while the total households' food waste is larger than those of these food-related businesses. Furthermore there are not penalties for not following or meeting the regulations set out by this law, even if the food-related businesses cannot achieve the goal such as reducing 20% of food waste within 5 years, no fine will be levied. Food waste isn't only produced by the

food related businesses, but also by households. The recycling laws need to reconsider fit to the household food wastes.

4.3 Local Policy

Personnel at the Kyusyu Regional Agricultural Administrations Office Oita branch, from the Ministry of Agriculture, Forestry and Fisheries were interviewed about the Food Recycling Law in Oita. There are six methods of recycling to produce re-cycled products such as “Feed”, ”Fertilizer”, “Oil and fat products”, “charcoal products” and “Ethanol”. The food wastes generated from food industries were collected by the private food waste collectors and take the wastes to the recycling facility. However, this law does not apply for household food wastes.

Oita city does not have recycling facility. Therefore all the food wastes generated from household go to incinerators or landfills except for those individuals using compost. According to Oita city personnel, the compost is lent to citizens, if they request it. Since 1992, the total number of lent composts is 12,488. However, these are not functioning well and the Oita-city personnel are not sure if people are using it or not. Presuming all composts are functioning well,

the percentage is only 6.8% (Computed as: 12,488÷183,458 (households in Oita-city 2008) x 100 = 6.8%)

Almost 93% goes to incinerators or landfills. There are two incineration facilities and landfills within Oita city. The first one is Fukumune environmental center which has a recycling center (not for food), incineration, and landfill. The second one is Sano center having an incinerator and landfill area.

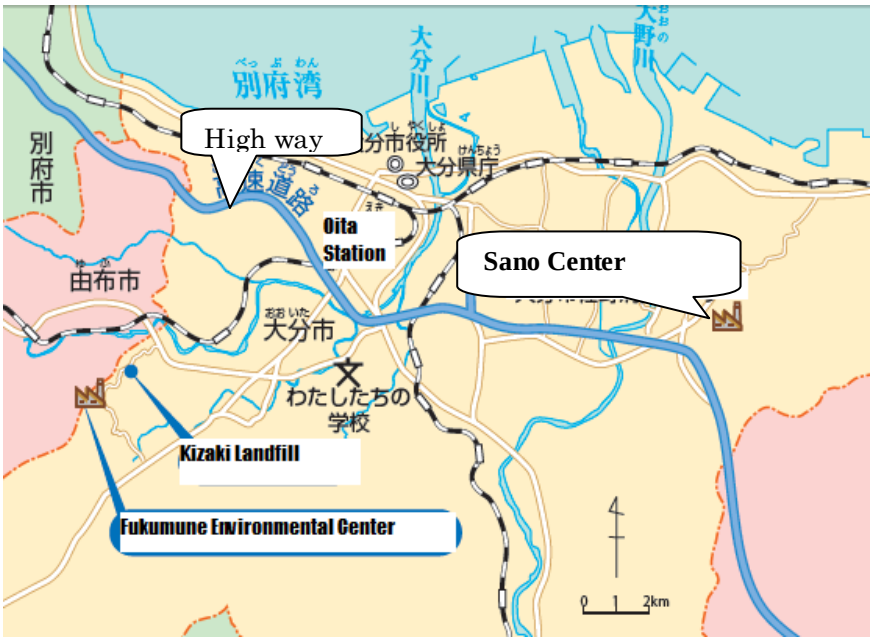


Figure 4.5: The Location of Sano Center and Fukumune Environmental Center

Source: Oita city, 2010

4.4 The Cost of Waste in Oita-city

Personnel from waste management office in Oita city municipal were interviewed about the situation of waste management in Oita City. As indicated below the weight of the waste per person per day was determined and the percentage was sorted according to the type of waste generated.

Calculations on the cost for dealing with food waste using Table 4.1 data:

505.6g÷678.8g=0.7445

0.7445 is the proportion of burnable among whole waste

0.7445×0.6863=0.5110.

The food waste is 68.63% among burnable waste in the table, so the food waste is 51.10% among whole waste.

505.6×0.68.63=347g (food waste per person a day)

42yen ×0.511= 21.5 yen

Therefore the estimated cost of food wasted per person is 21.5 yen per day. The total waste generation from food products within Oita-city costs about 3.74 billion yen annually. According to the interview with Oita-city hall officials, the food loss is about 50% of the total food waste. The estimated food loss is

about 173.5g. Comparatively, this average is similar to that of Japan's total average. (Ministry of Agriculture, Forestry and Fisheries, 2007)

The total cost for food loss is 1.86 billion yen and this is only for Oita city. This is a clear indicator of the monetary losses due to food wastes. If the entire prefecture is considered then, it would mean much more than this.

Table 4.1: The Volume and Handling Cost of Waste in Oita-city.

The weight of the waste per persona day

	2008
Burnable	505.6g
Non-burnable	27.5g
Recycable items	145.7g
Total	678.8g

The propotion of burnable waste

	2008
Burnable(food)	68.63%
Burnable (non food)	19.99%
burnable plastic	1.20%
recycable plastic	1.79%
paper	8.17%
non-burnable	0.22%
Total	100.00%

The waste dealing cost per person(2008)

	one day	one year
one person	¥42	¥15,504
Whole Oita-city	¥20,050,000	¥7,317,570,000

Source: Oita city 2010

4.5 Survey Results

4.5.1 Respondents' behavior for shopping

Shopping time

This section indicates different shopping time with relation to the varying occupations. occupations effect shopping times. If consumers have traditional full-time jobs in which they work during daylight hours on weekdays, they can only go grocery and other shopping after work. If they are homemakers or are unemployed, they can go shopping anytime during the day including weekends. Hence, it is important to know their preference or time they are able to shop before looking at what people choose to buy or consume.

Figure 4.6 shows the nature of respondents shopping time. Over 50% of housewives and pensioner, and unemployed go shopping around daytime. In particular housewives do not go shopping after 6 pm where as pensioners and the unemployed shop during daytime. It is suppose that they have time in daytime and most of shops are open during daytime.

This section indicates the time when people go to shop and the criteria for choosing the shop. Their criteria for choosing the shop are very important for understanding their demand. The shopping time is almost directly correlated by

occupation. If individuals who go shopping are homemakers, it will be anytime during the day. If they are office workers, the time for shopping is determined by their free time.

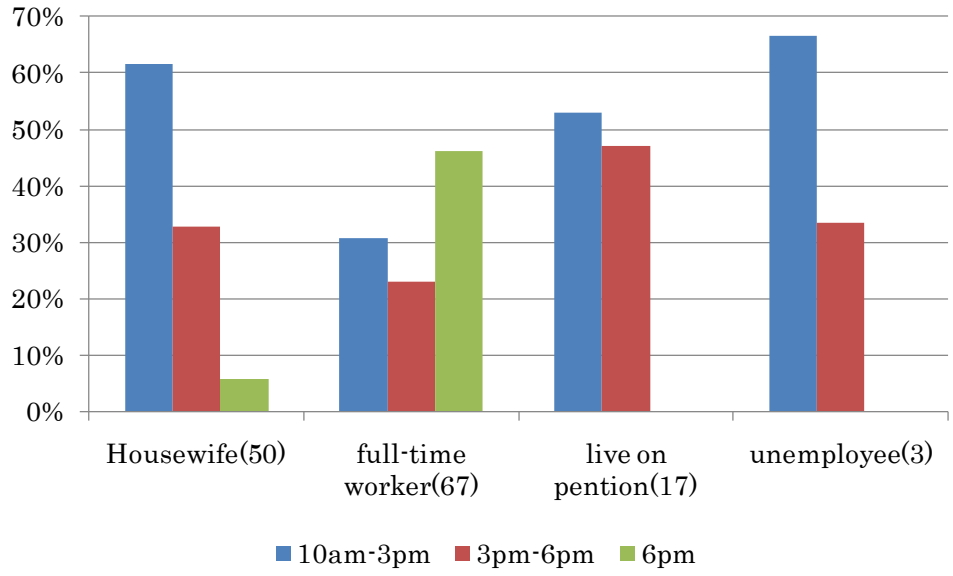


Figure 4.6: Proportion of shopping time according to each occupation

The biggest reason of choosing the store is the variety of food, and convenience of location. People don't care about the products cheapness, as per this survey results. Besides, in Oita most of stores sell food at the same price. There are no price differences and hence, they give priority to convenience. Abundance and variety are also related to shopping for convenience so they can buy anything from one store. One significant thing is that the people who go

shopping after 18pm have jobs during the day and besides these people don't have time to go shopping in daytime. The major concern of these people is the convenient location of the shop. Most of supermarkets close around 20:00 PM, so the shopping locations are limited to the stores which are still open after 20:00 PM.

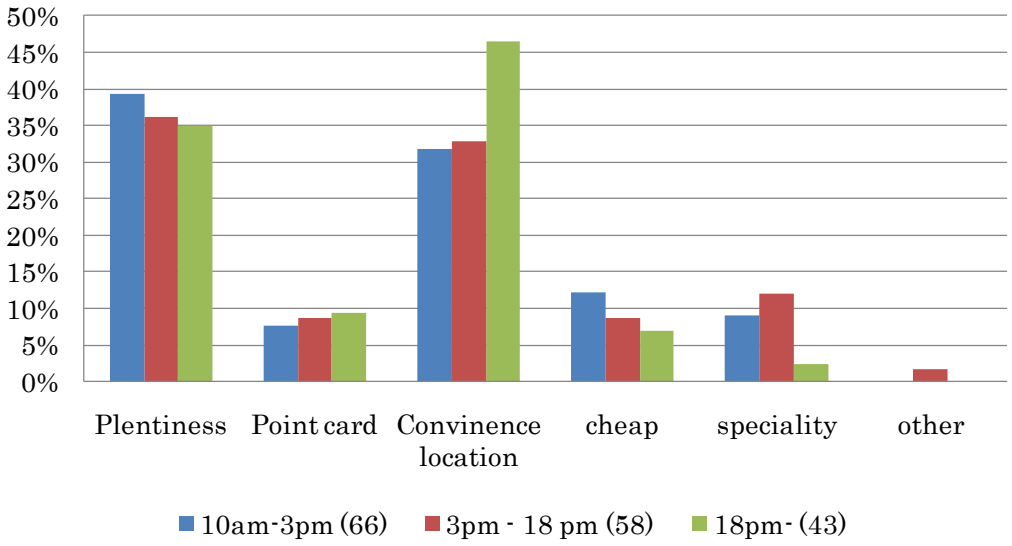


Figure 4.7: Respondents' Shopping Time

Decision making

People with jobs have less time than those without job to shop and consequently about 40% of the people do not decide the menu before buying.

While the difference is that almost 80% of housewives decide the menu before buying.

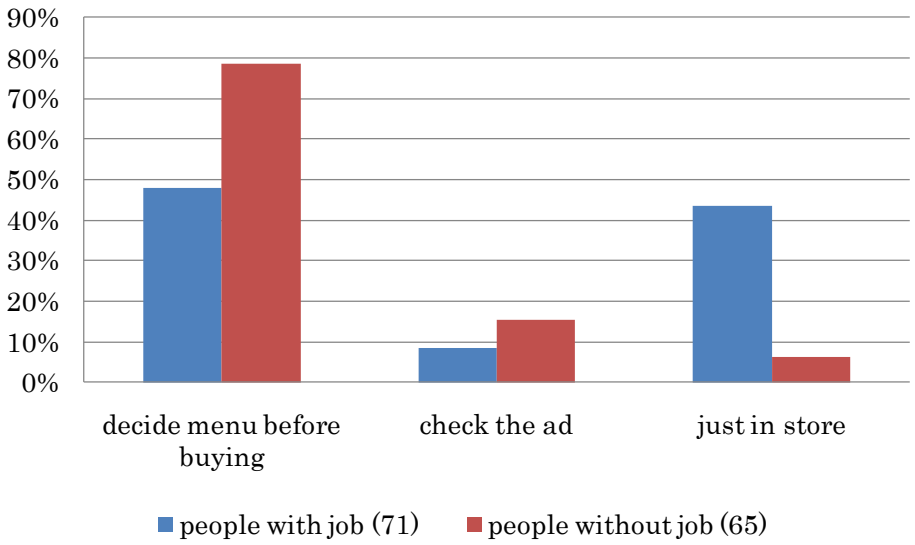


Figure 4.8: Respondents' Decision Making Behavior

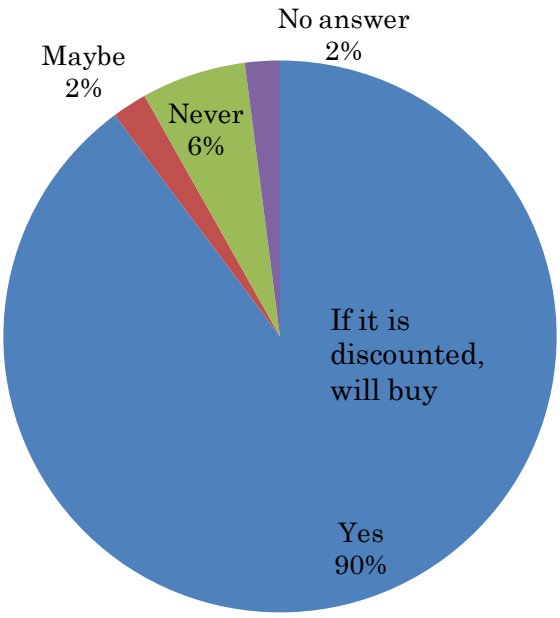
4.5.2 Attitude about expiry date

The sample size used in this study was 49, and the average age was 24.6 ± 9.6 years. 86% of respondents were Japanese the remaining respondents included Japanese-Americans, Japanese-Filipinos, Burmese, and Koreans. 80% were students, 12% businessmen, and the rest were APU staff, and housewives.

4.5.3 Willingness to buy

The results to the question of whether or not people chose to buy onigiri near and after the expiration date question is indicated in the figures 4.9. About 90% of respondents said they would choose a discount priced onigiri close to its expiry date rather than a similar regularly priced item (not close to expired date) one. As depicted in The Figure 4.10 shows the less-than ogive curves for the willingness to buy responses and the average discount price is 80 yen (assuming regular price is 100 yen). The results illustrate that half of the respondents were willing to buy close to the expiry date if the price was as low as 80 yen. As revealed in Figure 4.11, surprisingly, 69% of respondents said even if the onigiri had already expired, they would buy under certain conditions – depending on the time past the expiry or the discount price. A respondent commented that if he planned to eat the onigiri immediately, he may go for the expired product. Half of respondents were willing to buy the expired product if the price was as low as 40 yen. As per the current government regulations, expired products are impossible to sell. Manufactures and food retailers are so concerned about the expiry date that they enforce a ‘one-third’, rule and immediately remove items after two third of the pre-expiry duration, even if the item still has one-third of its edible life left.

However, looking at the survey results, it is clear that if the items are discounted, people would buy them even close to expiry date. It can therefore be concluded that offering a price discount can help in reducing Onigiri waste, and consequently in saving environmental resources.



N=49

Figure 4.9: Respondent Attitude Towards Close to Expiry Date Onigiri

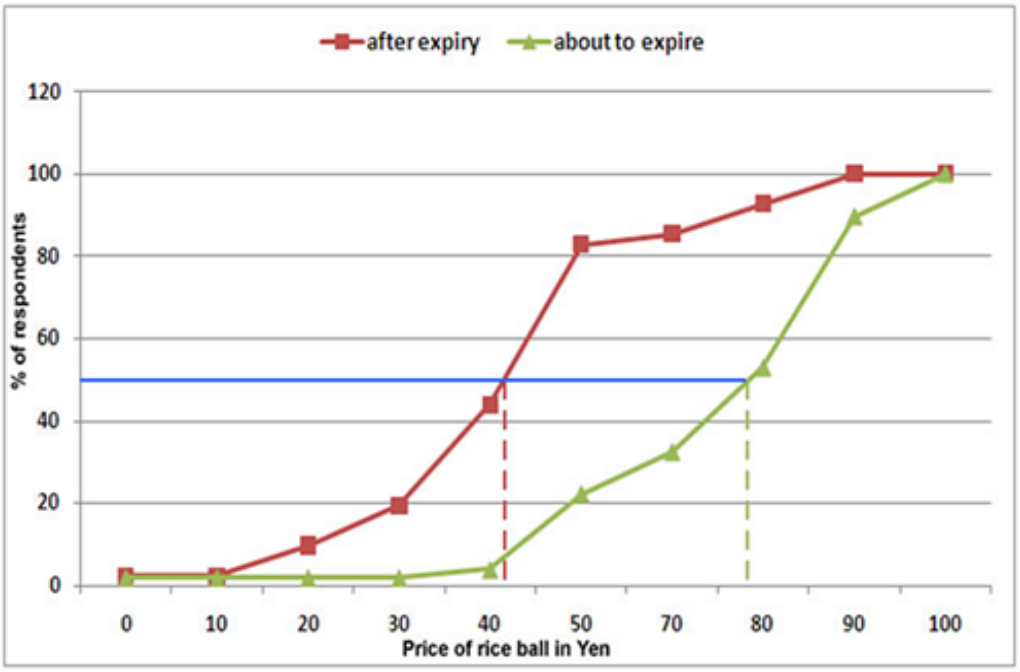
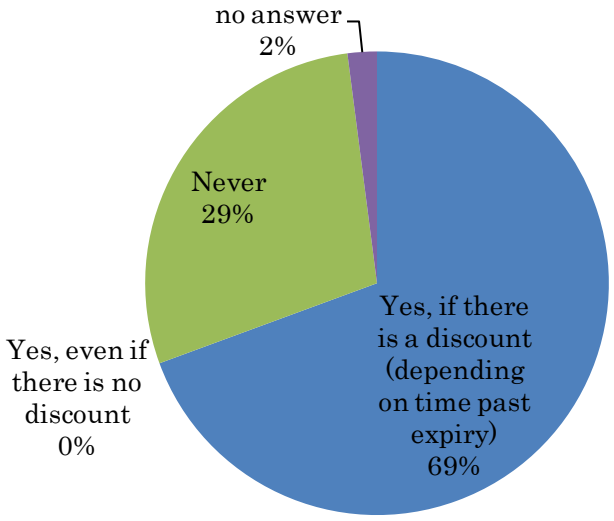


Figure 4.10: Less-Than Ogive Curves For the Willingness to Buy Responses.



N=49

Figure 4.11: Respondents attitude toward after expiry date Onigiri

4.5.4 Attitude about food waste

It is somewhat difficult to compare Oita, Japan, and United Kingdom data because the categories are little bit different. In United Kingdom, leftover is the main type for food waste, but in the documentation in this Oita study, this reason was the first reason. The survey and documentation study was conducted separately. However, considering the category, in this study, people in Japan tend *not* to have leftovers after their meal. People eat the leftover the next day. In this study, "out of date" product is the main reason for throwing away food. Next is rotten or moldy, so people in this study are very concern about the expiry date. In Japan's data, rotten or moldy food is the biggest reason given. When asked, people indicated that they throw away regardless of the taste, 4% of people throw away as they dislike the taste.

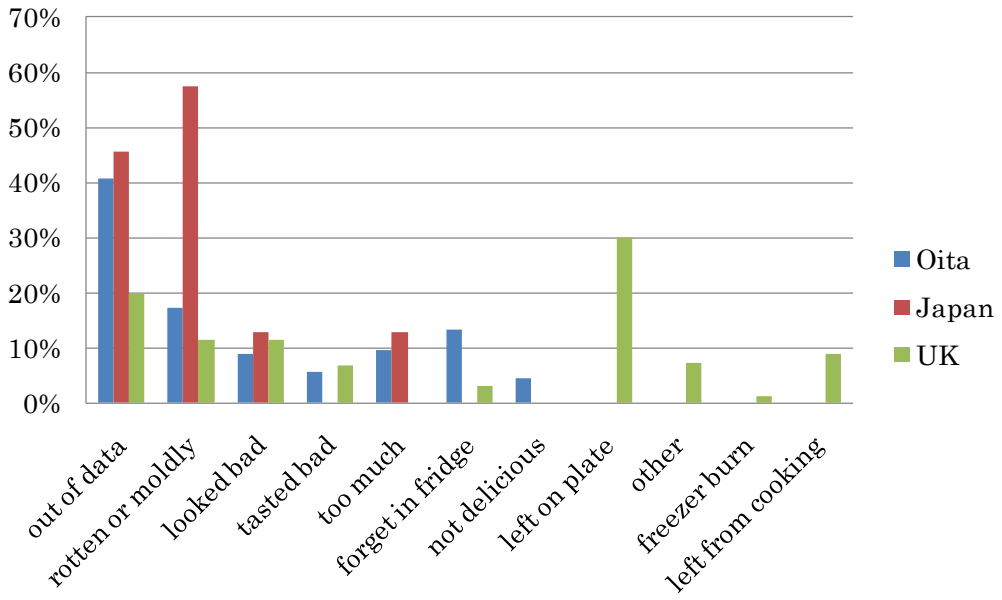


Figure 4.12: Reasons for Throwing Away Food

Safety first attitude

Food losses affect the environment. Food losses wastes food and the waste disposal need a lot of energy for dealing with. Figure 4.13 shows, about 70% of respondents think about reducing food waste. However, they are more concerned about food safety. Almost half of the survey respondents were concerned with the expiry date. After the expiry date they throw away food and only 3% of respondents reported that they have composted food wastes. Other respondents do not compost food wastes but are aware of the practice. One of the problems is that they do not know how to compost food wastes. Respondents said they do not know how to start reducing food wastes because of the lack of

information about the problem of food wastes as well the absence of appropriate incentives.

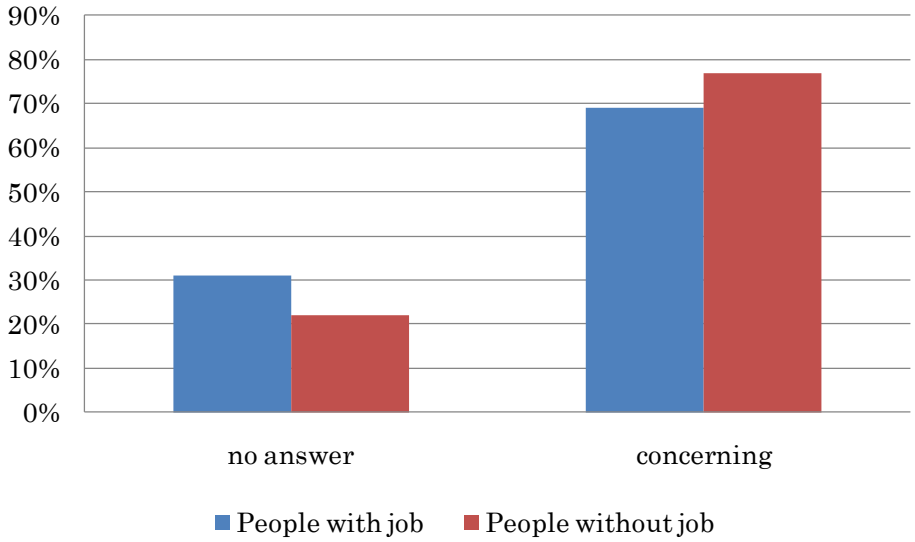


Figure 4.13: Concern about Food Waste Reduction

The concern for food safety was prevalent among respondents across education, age and employment. This is an important issue that influences the amount of food wastes among Japanese households. In my research, most of people are concerned about reducing waste and they know the environmental impact caused by food waste, but most of them were more concerned about food safety. The people who have higher education levels are more concerned about expiry dates. On the contrary, they have knowledge about food waste damage, the environment, but they do not do any action to protect the environment. Even through people may be in their 70s, they tend not throw food away, but the reason

given to why they do not throw away food is just because they do not like to throw it away.

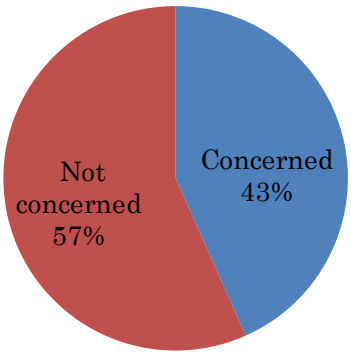


Figure 4.14: Respondents' Attitude about Food Expiry Dates

Education and food safety

Among people who go to university, about 47% were concerned about the date of expiry. Among people who did not go to university, about 41% were concerned about expiry date. Twelve percent (12%) did not provide any answer. Education does not seem to make a real difference with respect to food safety.

Employment and food safety

Among people who have jobs, about 42% were concern about expiry date. Among people who don't have job about 46% were concerned about expiry date. Twelve percent (12%) did not provide any answer. Employment just like education does not influence the attitude toward food safety.

Age and food safety

Among people who are over 60 years of age, 36% of them were concern about expiry date. Among people who are under 60 years of age, 47% concern about expiry date. These results are very significant as it indicates that seniors people are more conscious about food wastage. Possibly, seniors people with post-war experiences of food shortages are more concerned about food availability than with food safety.

Age and throwing food

Age also had a high degree of importance related to food waste behavior. Figure 4.15 indicates that the total number of housewife and pensioners 89% from the data analyzed in this research report. Analyzing these results, people of 70 years of age and higher live with pensions, and their experiences during war taught them to save food and not throw it away. People from 30 to 49 years of age

may have growing children, which eat more than average, limiting the likelihood of leftovers. Working people aged 50 to 69 years are able to buy the food which they want because of their income and savings. They tend to buy more food than they can actually consume resulting to more food wastes.

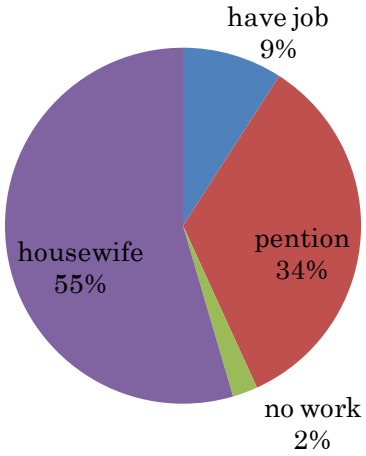


Figure 4.15: Occupation of people over 70

4.5.5 Composition of household food waste

Compared with Japan, Figure 4.16 indicates the grain and fruit are the main food losses in United Kingdom, while vegetable and grain are the main food losses in USA. Figure 4.17 indicates the vegetable and processed foods are the main food losses in Oita. This could be due to the fact that vegetables are primarily sold in supermarkets, and that processed food has relatively short shelf

life. In United Kingdom, bread waste is high. Fruit waste is relatively high in both Japan and United Kingdom.

According to the survey, vegetables and processed foods are the main source of household food wastes. Other foods stuffs such as meat, fish, milk, and fruits are considerably less.

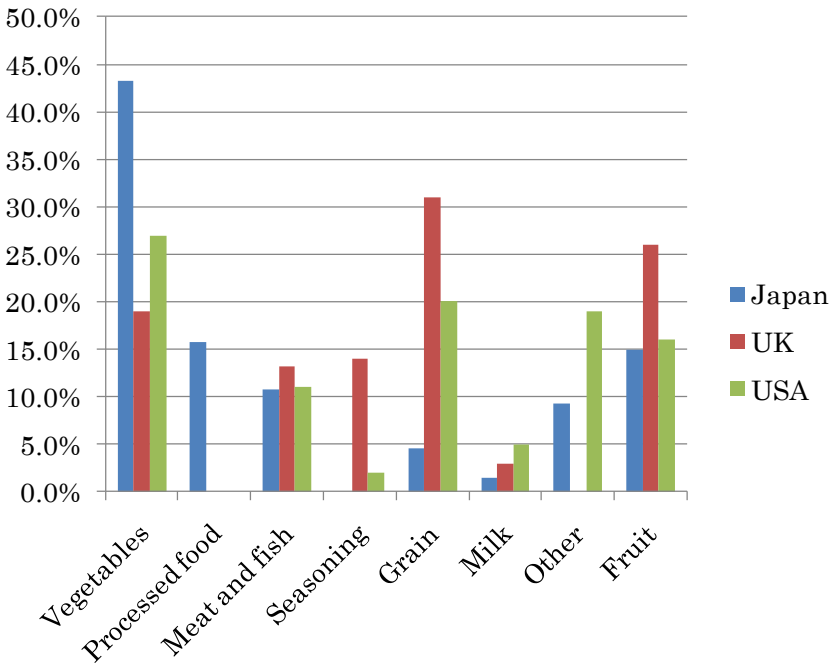


Figure 4.16: Food Items being Thrown Away Japan, UK, and USA

Sources: (Ministry of Agriculture, Forestry and Fisheries, 2007; Jones, 2004; Waste & Resources Action Programme, 2008)

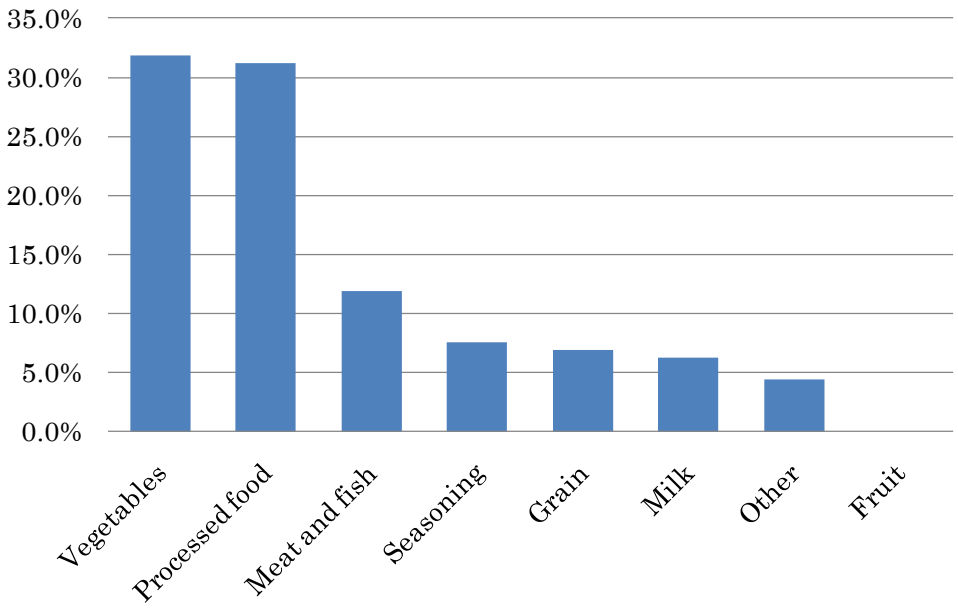


Figure 4.17: Composition of Household Food Waste in Oita

4.5.6 Reasons for household waste

Out of the 147 respondents in the study, 22% of respondents said that they never throw away food waste. Of those who admitted to having household food waste, (40%) cited expired food as the reason for their throwing away food. Rotten food or moldy food was cited by 17%. Summing the figures of the first four rows it can be seen that 80% of household food waste comes from food that has not been cooked or eaten see Table 4.2.

Table 4.2: Reasons for Throwing Away Food

Reasons for Food Waste	Number of Responses	Percentage	Remark
Food had expired	64	41%	Food that has not been cooked/used (80%)
Rotten or moldy	27	17%	
Forget in fridge	21	13%	
Looked bad	14	9%	
Too much	15	10%	
Tasted bad	9	6%	
Not delicious	7	4%	

It is unfortunate that such a large amount of unused food is being thrown away yet Japan is importing spending large amounts of money for importing food as discussed in the literature. This is both costly for the nation and for the environment. More food is coming into Japanese households than what is necessary for eating. It is thus necessary to understand how and why people tend to have more food in the house than what they need. Therefore the following section investigates some of the reasons for food waste

4.5.7 Factors influencing household food waste

Influence of age on household food waste

Figure 4. 18 indicates that the highest proportion of respondents who do not throw away food waste was from two age ranges: 30-39 years and over 70 years. These are contrasting age ranges because for senior people it can be said as also shown in literature that senior people tend to use less food and are also more cautious about food consumption. This notion was also supported by some of the senior people that were interviewed who said that due to their post-war hunger and starvation experience, they feel guilty about wasting food.

Some possible reasons for explaining the trend in 30-39 age range could be that they have growing children, and children eat a lot, so there is no left over. Figure 4.19 shows that the percentage of respondents never throwing away food with children under 20 and without children. Households with children tend not to throw away food age range from 30 to 59. In their 20s, most of their children are too small such as baby, so they do not eat much. Sometimes to make them eat is difficult so the food remain untouched. This is supported by and interview with a food shopper with three children who said she never throws away food because her children eat a lot:

"I have to make lunch box for my children. I always buy food soon after there is no food at home. It is difficult to keep food for long period at home."

The percentage of people who said they never throw away food is high for those in their 50s in Figure 4.18. However, the percentage of those having children under 20 is small. People from 50 to 69 years of age are still working so they can afford to buy food which they want, and their children grow up, and leave.

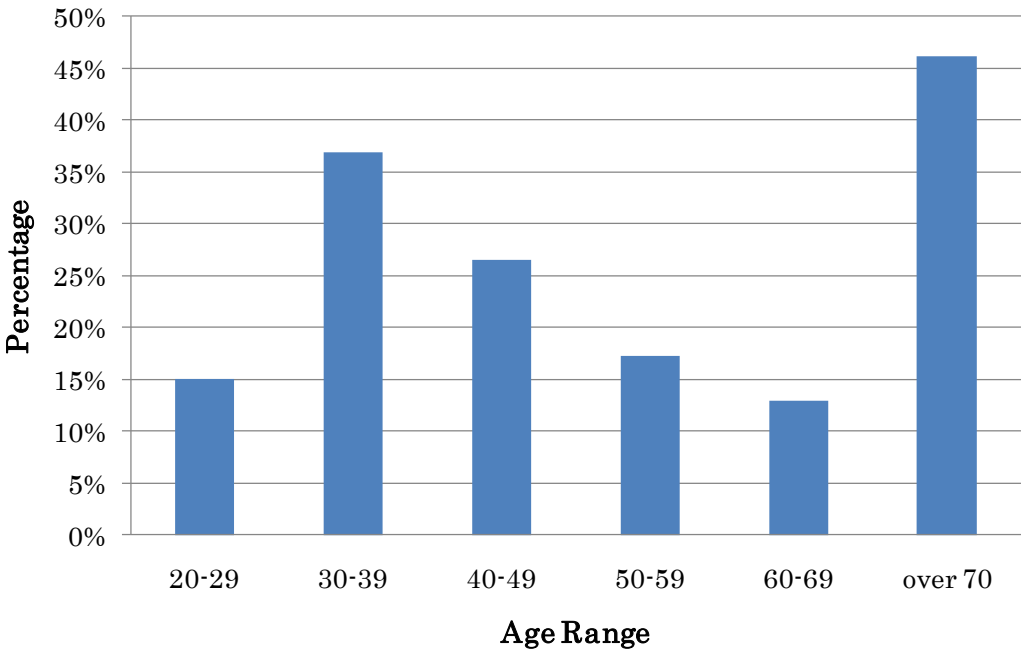


Figure 4.18: Proportion of Residents Who Never Throw Away Food by Age

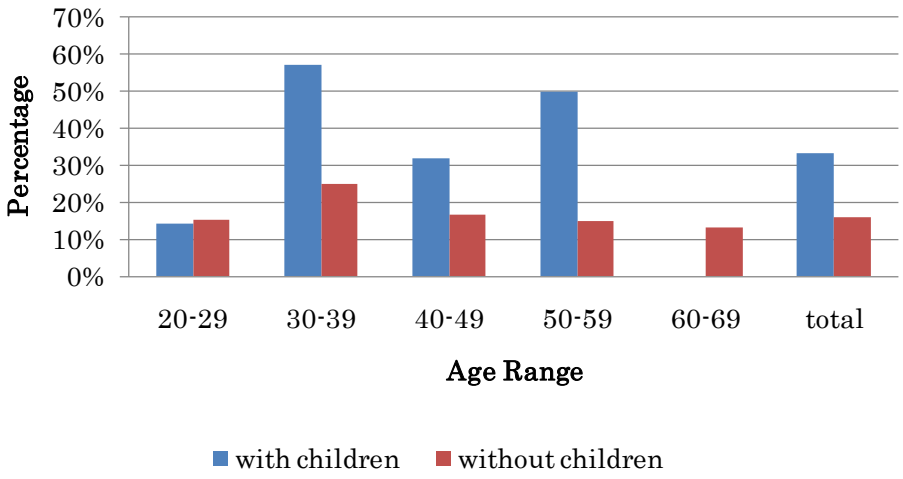


Figure 4.19: Respondents with children by age

Relation between shopping behavior and food waste

Figure 4.20 shows that 75 % of people tend to buy on impulse. Figures4.21 indicates there are significant different attitudes seen about throwing away food. People who don't do impulse buying tend to not throw away food. Moreover, among people who do impulse buying the reason why they do is because it was cheap or they feel it is a good value. (See Table 4.3) Therefore, they think that items that are but in the end, it ends up in trash because it is too much or they forget to eat and then they end up "expired". It can be said impulsive buying is not a good value even if the items are cheaper.

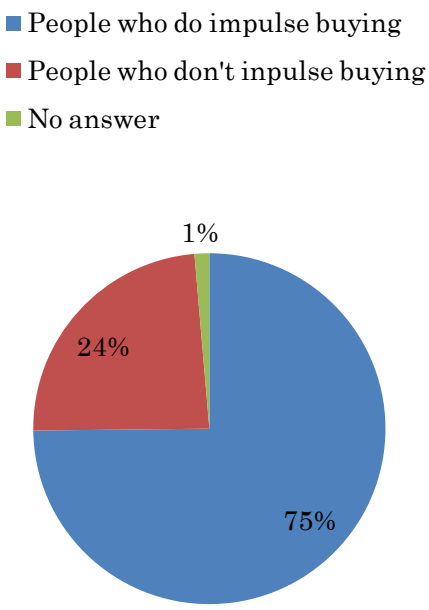


Figure 4.20: Respondents' Attitude about Impulse Buying

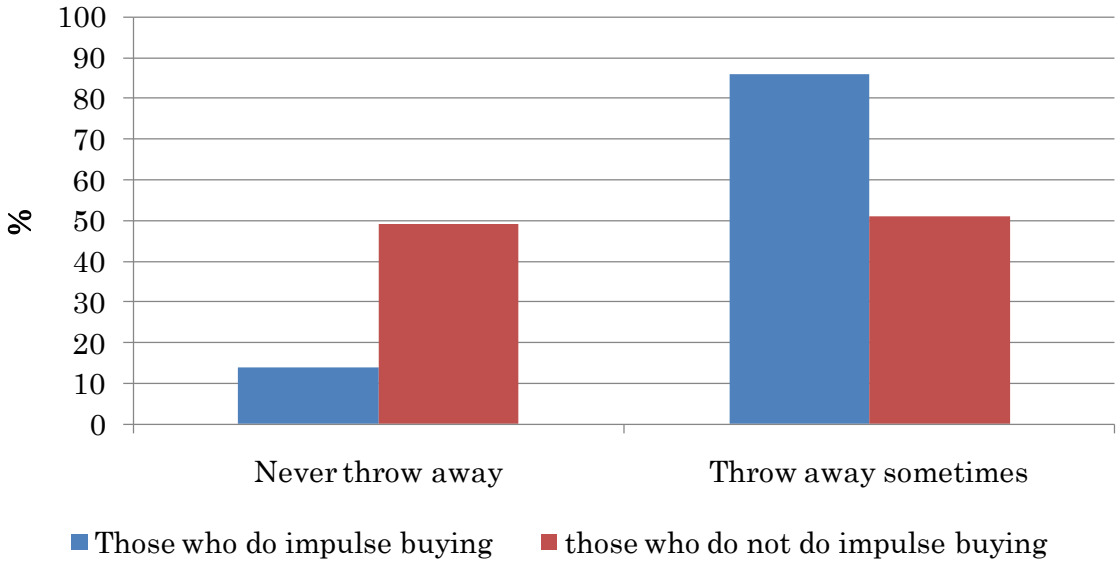


Figure 4.21: Comparison of Respondent Who Do Impulse Buying and Who Do not Throw Away Food

Table 4.3: Reasons Stated for Impulse Buying

Reason	Percentage
Discount	67.6%
Sell in bulk	8.8%
Selling with free sample	2.9%
Selling with recipe	7.4%
With all ingredients	0.7%
Other	12.5%

Relation between occupation and food waste behavior

According to the Figure 4.22, the graph indicates that house workers and office workers' behavior of throwing away food is similar as 18% of the housewives and 20% of the office workers throw food away. The remarkable difference between occupations is that over 30% of people the who live with pension, part-time, or unemployed said that they never throw away food. Therefore, financial restrictions are the factors that induce people to eat food without wasting any.

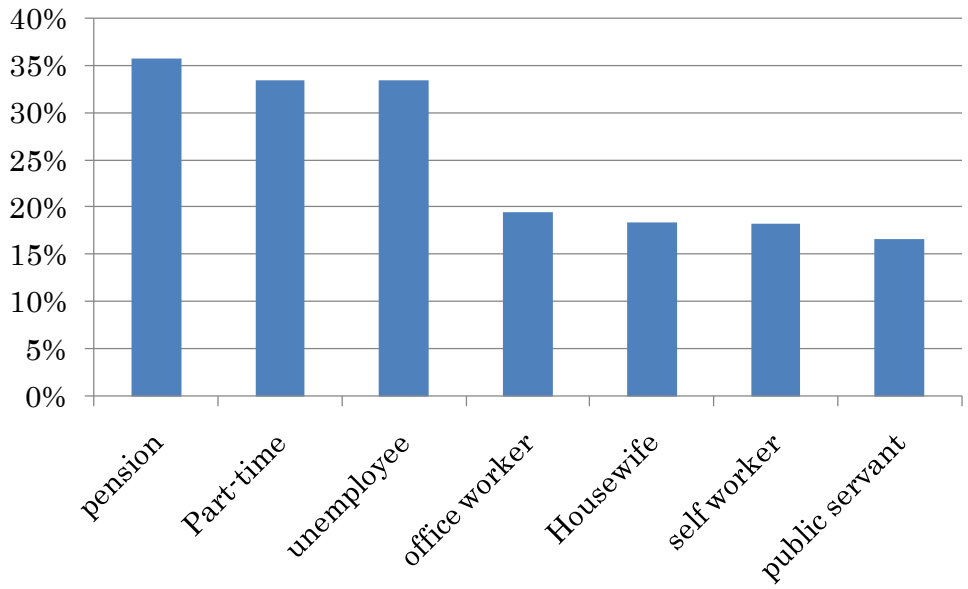


Figure 4.22: Occupation and Throwing Away Food

Education and food waste behavior

Figure 4.23 shows education in school does not affect the behavior of throwing away food. Education does not affect the awareness about food waste. Even if they have some knowledge about the consequences of food wastes and the quantities they throw away, people do not seem to practice it. This indicates that there is no relation between the education level and the quantity of food thrown away. According to the results, the reduction or increase in food waste does not relate to how much knowledge people have about food waste and the consequences.

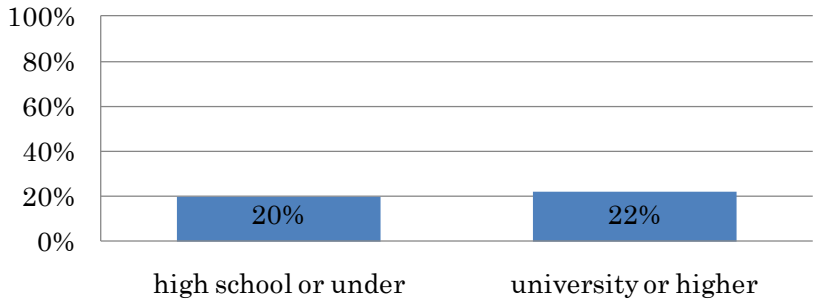


Figure 4.23: Proportion of People who Answer never Throw Away according to Education

Attitude regarding household food waste recycling

Among 147 respondents, only 3% said they use compost. Most of respondents said they squeeze out water from food waste before throwing the food waste. They explained that by squeezing water out of food waste, the total energy required for incineration plant would be somewhat reduced. But they do not take specific action about reducing food waste.

4.6 Case Study of Shopping Behavior

The researcher went shopping with four people, and observed and interviewed them while they were buying food items. Person A and B are single but live with their parents, so most of time the mother cooks. These people

sometimes go shopping for food and cook for their family. Therefore, they do not have to think about cooking meal every day. If they buy extra food and unnecessarily food, their mothers manage to use these. Their mothers are 60s. However, they have obsession about some favorite food. One person said she buys bread and vegetable in certain store in Tokiwa department store. Despite distance from her house, she goes there for the items. Person B said she likes lamb meat, so she goes shopping to a specialty shop.

Person C and D are married, and they have to cook almost every day, and also they have job. So they said they do not have enough time to think about meal. They decide to buy food in the store. So sometimes, they buy too much food unnecessarily so they eventually throw them away. They are aware about environment, but they do not know how to start doing something. They think this kind of activity becomes extra work. So they hesitate to start. However, the parents of person A and B are doing something for the environment by composting and buying locally grown rice and vegetables. The parents of person B also cultivate vegetables in their garden. Person B belongs to a family of food manufacturers, so she knows about the expiry date mechanism. She said she

sometimes eats food even after expiry date, especially those produced by her family.

Below is a brief profile of the ladies, the researcher accompanied in their shopping for food items.

Person A: Most of meals for this household are made by the individual's mother. Sometimes this individual works late. Buy rice directly from a farmer. Person A uses compost and seldom freezes food because she does not like to forget it. Therefore she seldom throws away food.

Figure 4.24: Person A's shopping Items

Person B: Most of meal is made by her mother. She sometimes works late in the evening.

She is studying in graduate school now. Buys rice directly from a farmer.

Seldom throws away food. She buys vegetable and bread in certain stores.

She said she seldom thinks about environment when she throws away food. Her house does not have compost, and nobody think about food wastes. If there is any seminar about food education or food waste, she does not join. That is not a priority thing for her. She said if somebody close to her is concerned about food waste and environment, she may consider it.

Figure 4.25: Person B's shopping items

Person C: She prepares all her meals whenever she has time. She works late almost every day. She is so busy, so sometimes she forgets about items in refrigerator, and throws food away. Looking at her shopping items, most of items are eaten without cooking such as frozen food, yogurt, and noodles. She has no time to cook. Therefore she tends to buy too much food. She said she does not have time for preparing a list of items before shopping.

Figure 4.26: Person C's shopping items

Person D: She cooks during weekdays while she and her husband cook during weekend. She and her husband go shopping for food. She uses food delivery services if they are busy at work. However, the vegetables delivered to them are whole, so sometimes they cannot eat everything. When she buys the food, she thinks she can use them, but she does not cook every day, so some vegetables are left.

Figure 4.27: Person D's shopping items

4.7 Documentation of Shopping and throw away attitude

About 67% of the households surveyed did notthrow away any food. They said they hardly throw away food, but it does not mean they never throw away. Some respondents said if they have too much, they may throw away occasionally.

About the left over's on the plate wasted, Almost all households surveyed seldom had left over, because in the case of left over occur, they eat them next day. Sometime, they throw away miso soup, side vegetables, or sashimi as these foods are not easily or safely storable. One household keeps dog, so if they left over food, the dog can eat the left over.

Moreover, interviews revealed that how their shopping and consumption behavior was conducted. On November 2, a Yomiuri newspaper article said the Japanese government, the Consumer Affairs Agency decided to revise the "best before" labeling adding an additional explanation, such as "you can eat after the date". However, one interviewee said he knew that he can eat food after the date, but he is worried about how long food would be available to eat after being

opened. Because the label also says that once you open this, you should eat it as soon as possible. So many people cannot trust the date anymore. If he forgot the date when he unpacked the food, he might throw away it, so a survey of garbage bags in Kyoto-fu found many items which have still before the date. Many items were thrown away before the expiry date. One of the reasons is what interviewee said.

The other problem of expiry date system in Japan is “the one-third rules” According to the Agriculture, “Forestry and Fisheries Ministry, supermarkets and other retailers follow a customary practice dubbed the "one-third rule," under which products are removed from shelves when two-thirds of the period between production and the best-before date has passed”.

4.8 Observation of food waste in garbage

Bags with food loss waste are 9 among 22 bags. All 9 bags contained vegetable waste. Average weight was 399g in a bag. One bag contained whole rotten egg plants, remains of cucumber and ginger. Three bags contained left overs such as processed food; fried fish,

hamburger, and cake. Two bags contained left over fruits. The other bag contained noodle leftover.

This observation indicates that the vegetable is the main waste as well as the survey finding, however the left over is also the one of the waste.

4.9 Environmental Implication Calculation

The gap between Japanese intake and food consumption, is the country's food waste. Currently the gap is approximately 700 calories per person per day which is equivalent to 32 trillion calories being wasted in Japan based on the current population of 128 billion. Translated to rice, 32 trillion calories represents the amount of calories needed to feed approximately 42 million people. Moreover, one ton of food wastes generate about 4.2 tons of CO_2 (Next Generation Food website in UK, 2010). This implies that in Japan, food waste from onigiri alone produces about 46 billion ton of CO_2.

4.10 Summary of Findings

In this study results of this study have shown that a large proportion of food waste in Oita comes from uncooked and unused food. The observations as well as the survey findings reveal that the vegetable is a main constituent of waste. While very minimal food waste comes from table left overs. This is in agreement in Japan's culture to reuse leftover food. These results are in contrast to USA and United Kingdom results whereby most food waste comes from plate leftovers.

In one week documentations, people throw away just 'liquid' type dishes such as miso soup, if they have any leftover. The factor causing people to throw away is due to the impulsive buying. Education level is not a factor in this case. Individuals of 70 and over tended not to throw away food. This is likely due to the fact that these people lived during war time when food was scares and continued those habits so that even now they tend save food. In all cases, the household's awareness toward environmental issues is not high.

Table 4. 4: Summary of Findings

Factor	Trend
Shopping time	62% of housewives go shopping food around 10 am – 3 pm. 46% of full-time workers go shopping after 6 pm.
Priority for choosing shop for food	47% of shoppers who go after 7 pm said the convenience location is important.
Willing to buy	90% of respondents said they prefer to buy discounted onigiri which is closed to expiry date.
Age	46% of the respondents over 70 and 37 % of those around 30-39 said never throw away food.
Education	Higher School education does not influence to their awareness for

	reducing food waste. 20%.
Impulse Buying	14% of respondents who do impulse buying said never throw away food, however 49% of people who do not impulse buying said never throw away food.
Reason of impulse buying	65% said because of discount
Working /non working	36% of respondents live on pension and 33% of respondents without job said never throw away food, however only 18% of households and about 20% of workers said never throw away food.
Compost	Only about 6.8% of residents in Oita have composts.
Vegetable	32% of respondents said they have thrown away vegetables.

Chapter 5

Conclusions and Recommendation

5.1 Conclusions

The study showed that there is still considerable volume of food wastage being generated from Oita households. This implies that the pattern of food losses from households has environmental consequences not only for the present but also in the near future. Promoting food security depends to a certain extent managing household consumption in a manner that food wastages are kept at a minimum if not totally avoided. For Japan minimizing food losses is significant considering that most the food consumed in the country are sourced from other countries.

5.1.1 Pattern of Food losses in Oita-city

In Japan, the average daily food wastes generated per person has been estimated to be approximately 235.45g in 2008. This study revealed that in Oita a person produces about 347g which is about 100g more than the national average. One possible reason is the fact that garbage collection for household in Oita City is still free, so households can dispose as much as they can. Also, there is no accurate and regular measurement for calculating food waste, so it is difficult to

compare with other areas. It must be noted that the amount of food wastes for both United Kingdom and USA are over 200g. In 1945, Japan's household wastes per person were recorded to be only 37.5g (Takatsuki, 2004) Today people produce wastes six times more than in 1945.

5.1.2 Attitude about expiry date

There are four laws related to food wastes in Japan. All are related to food safety. Japanese government is concerned more about food safety than food security. Although Japan's food self sufficiency rate in only 40% a lot of food are being wasted because of adherence to expiry dates labeled on foods. Government made several laws for manufactures and food service institutions to strictly observe expiration date. Stores and food businesses are so concerned about the expiration dates so as to protect their names and business. As a result almost one-third of what they sell are being thrown away earlier than the expiry date. With this practice volumes of foods are being wasted. However, this study shows that about 90% of respondents are still willing to buy, 90% of people answered to buy even close to expiry dates.

5.1.3 Volume and amount of food thrown away

In 2008 the total food waste was about 59,000 tons in Oita City households alone. This amount is 68.63% of total burnable waste, and 50% of total wastes including non-burnable. The cost of incineration and landfill was 3.74billion yen or nearly 10 million yen a day.

5.1.4 Volume and amount of recycled food wastes

In Oita, there is no food re-cycling center operated by the municipalities, and there is no law about recycling food waste from households, so all food wastes except compost individually go to incineration and landfill in three areas in Oita city. Oita city encourages people to use compost in their house by providing free use of simple tools and supports half of the price for buying compost. However, only 5.6% of total Oita population practices composting. The resistance to composting is due to practical reasons such lack of opportunity for using compost and lack of knowledge. People look at composting as additional burden. Interview results showed that people agree to the importance of knowing more about the environmental impacts of wasting food. It has been suggested that incentives can be given to people to encourage them to minimize wastage as well as to motivate them to re-cycle food wastes. It was raised that if people can see

the real benefit of re-cycling as well as minimizing food losses from households, attitude will eventually change. One example cited is the use of discount coupon on food items. Small concrete steps must be taken and sustained. What it takes is a good start at something that will show benefits to people. For example, most of the people have on their own practiced waste separation even without any personal benefits but because most people do it, waste separation has become customary already and is continuing.

The study showed that vegetables are the most common commodities being thrown way. The same is true for the United States where vegetables are usually being thrown away. Both US and United Kingdom waste huge volume of grain while Japan seldom wastes grains, especially rice. It is because Japan uses 100% of its rice production domestically. US also the most waste in US are also mainly vegetables. However, significant difference between these countries and Japan, exists with respect to grains especially rice. Japanese believe that wasting rice is bad so they use left over rice for making lunch boxes. Food losses or wastage from grain is very low in Japan.

5.1.5 Household food losses

This study showed that people age 70 and over 70 seldom throw away food. Also, the people who are not impulse buyers hardly throw away food. However, even people 70 or over 70 who live with their children's family, tend to throw away food on a moderate level or occasionally. It means that those who manage the household largely determine throwing away food.

The study also revealed that majority of respondents is willing to buy food close to expiry date provided they are sold on discounted prices. Majority of the respondents buy foods on discount.

5.1.6 Waste reduction strategies

To reduce waste in household need not only the effort of household, but also need food services such as supermarket and food manufactures, and government. All sectors play important role in reducing food wastes. Awareness about the impacts of food loss is important.

5.1.7 Shopping behavior

People over the age of 70, who are not impulse buyers and those who are non-working or unemployed housewives seldom throw away food. The seniors who have experienced food shortages during the war years are more concerned

about avoiding food wastage. In the same way those who plan their shopping and those who are full-time housewives are concerned about buying only what are actually needed and can be consumed by their families. These result to less food losses or wastage.

5.1.8 Environmental impacts of food wastages

Japanese waste 32 trillion calories (population 128 billion). Just about 42 million people would be saved for a year. And food waste in Japan produce 46 billion tons of CO_2 each year.

5.2 Recommendation

5.2.1 Household

1. Avoid impulse buying through proper planning of menu.
2. Buy food close to expiry dates.
3. Use food delivery system if there is not enough time for wise buying.
4. Check stored or existing food before shopping for additional foods.

5. Put the dates when goods were unsealed or opened to avoid unnecessary wastage.
6. Buy only what can be timely consumed.
7. Buy only what can be eaten to avoid wastage.
8. Use the leftover food or re-cycle them the following day.
9. Ask for doggy bags if there are leftovers from restaurant food.
10. Be more environmentally conscious.

5.2.2 Government

1. Reconsider the prescription of expiry dates on food based on consumer surveys.
2. Encourage households to buy and consume domestically produced or grown foods.
3. Encourage and support farmers to produce more from existing agricultural lands.
4. Reconsider the recycling law to expand its coverage to households in addition to industrial manufacturers.
5. Collect more precise statistical data as bases for policies and legislation related to food wastes minimization or avoidance.

6. Collect statistical precise data and analyze the data

5.2.3 Education campaign

1. Conduct information and education campaign for households to understand the problem of food wastages.
2. Provide simple and understandable strategies or tips for reducing food wastages in households.
3. Introduce small changes that can be sustained related to food wastage minimization.
4. Introduce techniques or approaches on food planning, storages and cooking sufficiently with minimum or no wastage at all.
5. Provide recipes for using stored and refrigerated foods.

5.2.4 Store owners

1. Sell goods that are close to expiry dates at discounted rates, instead of throwing or discarding them.
2. Sell items in appropriate sizes for different family composition or family size.
3. If possible, sell more domestically grown or produced food items.

4. Conduct regular surveys to determine the opinions, needs and demands of the community they are serving and how to possibly minimize food wastages

5.2.5 Community

1. Promote environmental awareness about environmental impacts of household food losses.
2. Organize community for food production and re-cycling of inevitable food wastes from household.

5.2.6 Future research

1. Document best practices regarding food losses minimization by households. Expand the scope of similar study to capture issues and strategies by greater number of households in different places.
2. More and detailed studies must be conducted about environmental and economic costs of food wastages.
3. Evaluation of the effectiveness of existing policies and regulations regarding expiry date labeling on food.

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Appendix A

The questionnaire of food losses

According to the ministry of Agriculture, forestry and fishery, almost 40 % of food waste is still edible. Japan has few natural resources and is importing about 60% of food from other countries, whereas a lot of developing countries are suffering from the shortage of food. This is the serious issue both Japan and other countries. If the import stopped, serious food shortage would occur in Japan. It is important to recheck our food consuming behavior as soon as possible. This is the reason why I try to gather this questionnaires. This questionnaire just is used for my thesis data, and I never use another proposes.

Ritsumeikan Asia Pacific University
Ikuko Morisaki

Answer date: year month date

The answering place :

<About Respondent>
Sex: 1) male 2) female
Age: 1) 10s 2)20s 3)30s 4) 40s 5) 50s 6) 60s 7) 70s or more

Occupation: (Respondent) 1) student 2) office worker 3) public servant
4) Self-employed5) part-time worker 6)housewife or husband
7) Unemployed 8) live on pension 9) other ( )

If other members except the respondent earn money, please fill out the occupation according to the above categories.
( )

Final education: 1) Elememtary school 2) Junior high school 3) High school 4) Undergraduate 5) Master 6) PhD.

The total amount of income in your family (Would you please fill your income, if you don't mind)

Less than 2 million 2) 2 million or up to 3 million 3) 3 million or up to 4 million 4) 4 million or up to 5 million 5) 5 million or up to 6million 6) 6 million or up to 7million 7) 7 million or more

Resident district:

The family composition

<About the shopping pattern>

How many times do you buy food a week?
Every day 2) buying in bulk and buying more in weekday 3) buying in bulk and buying more in weekend 4) Home delivery and buying more
5) other ( )
Where do you mainly buy food?
Integrated supermarket 2) grocery store 3) the food section in department store 4) convenience store 5) other ( )

What is the criteria for choosing store?
Because I can buy everything in one stores
Because the store provide a point card
Because the location is convenient, and it opens late.
I always check the advertisement and choose the cheapest store
I have favorite store for each item.
Other ( )

What time do mainly you buy food?
In the morning in weekday 2) 12- 3 pm in weekday 3) 3-6 pm in weekday 4) after 6 pm in weekday 5) in the morning in weekend

6) 12-3 pm in weekend 7) 15-6 pm in weekend 8) after 6 pm in weekend

When do you decide what you buy?
After deciding today's menu
After deciding two or three days' menu
After looking the stores' ad
In the store

Do you decide the budget for food when you go to store?
Yes 2) no

If "yes" in no.6, please which is your pattern?
Within the budget 2) over the budget

Do you buy something even if you have already at home sometime?
Yes 2) no

If "yes" in no 8, what kind of food often buy?
Deli 2) perishable foods 3) processed food 4) other ( )

If "yes" in no 8, what is the reason?
Because the store has on special sale
Because the store sell items on discount
Because the store sell cheap items in bulk
Because the store gave demonstration with the free sample of food
Because the store show the recipes of the item
Because the store sell the items with other ingredients introducing the recipes.

If you throw away sometime, what kind of food often?
Vegetable 2) meats 3) fish 4) paste food 5) ham and sousage 6) Tofu and deep fried tofu 7) seasoning 8) Instant ramen 9) bread 10) milk 11) dairy products 12) Natto 13) Never
14) other ( )

What is the reason?
Over the expiration data 2) become rotten or mold
Become look bad4) become taste bad 5) too much
Forgot it long time 8) Taste not delicious 9 other

If you throw away food, how did you get the food?
Impulse buying 2) I made a menu, but I didn't use it in the menu
present
If you try to do for preserving food, please tell me that.
When I bought food , I alsays preparing the ingredients everything and make them freeze
Keep them in the place with appropriate temperature
Nothing special
Other

If you try to do something about kitchen waste, tell me that
Make fertilizer with compost
Squeeze the waste and drain the water of waste
Try to reduce waste

If you have any opinion, please let me know.

Appendix B

Expired food Questionnaire

Recently, a lot of edible food is discarded because of out of expired day. Please tell me your opinion about that issue.

Age…… Sex…… Place where you write this questionnaire……..
Nationality……..3.
Occupation……..Date……..……..

How many Onigiri do you buy at convenience stores in a week?
Every day 1-3times a week 3-6times a week Never

If they discount a close to expired date Onigiri, which one do you buy regular price or discount price?
Regular price (fresher one) / discount price (close to expired date)
I don't buy

If you buy discount one, how much discount do you buy in tolerate price, when the Onigiri 100 yen.

100-90 yen 89-80 yen 79-70 yen 69-60yen 59-50 yen
49-40 yen 39-30 yen 29-20 yen 19-10yen 9-0 yen

If convenience stores discount food after expired date, what level do you tolerate?

(1) I don't want to buy
(2) I can buy even if it is no discounted (3) I can buy until:
0-4 hours 5-8 hours 9-12 hours 13-16 hours 17-20 hours
21-24 hours

If you buy the onigiri after expired date, how much discount do you buy in tolerate price, regular price 100 yen.

100-90 yen	89-80 yen	79-70 yen	69-60yen	59-50 yen
49-40 yen	39-30 yen	29-20 yen	19-10yen	9-0 yen

What kind of food do you tolerate if it expired?

If you have any comment of expired date, please write down here.

Thank you very much for your cooperation

Appendix C

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[neverthrow = 0]	4.934	1.010	23.880	1	.000	2.955	6.912
Location	[Age=0]	4.906	.270	331.252	1	.000	4.378	5.435
	[Age=1]	5.072	.000	.	1	.	5.072	5.072
	[Age=8]	0[a]	.	.	0	.	.	.
	[Occupation=0]	-.145	.269	.291	1	.590	-.672	.382
	[Occupation=1]	0[a]	.	.	0	.	.	.

[Education=0]	.798	.350	5.197	1	.023	.112	1.484
[Education=1]	.242	.281	.738	1	.390	-.310	.793
[Education=2]	0[a]	.	.	0	.	.	.
[buyingfrequency=0]	-.139	.280	.247	1	.619	-.687	.409
[buyingfrequency=1]	0[a]	.	.	0	.	.	.
[buymoreevenif=0]	-1.108	.941	1.386	1	.239	-2.951	.736
[buymoreevenif=1]	-.786	.918	.733	1	.392	-2.585	1.013
[buymoreevenif=3]	0[a]	.	.	0	.	.	.

Link function: Probit. a. This parameter is set to zero because it is redundant.

Appendix D

The questionnaire of food losses

According to the ministry of Agriculture, forestry and fishery, almost 40 % of food waste is still edible.　Japan has few natural resources and is importing about 60% of food from other countries, whereas a lot of developing countries are suffering from the shortage of food. This is the serious issue both Japan and other countries. If the import stopped, serious food shortage would occur in Japan. It is important to recheck our food consuming behavior as soon as possible. This is the reason why I try to gather this questionnaires. This questionnaire just is used for my thesis data, and I never use another proposes.

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1. Fill in the 2-4 page questionnaire
2. Put marks on the items which you bought on first day.
3. Measure the items according to the sections of page 5, and fill in the table in page 6. If you buy the food every day for just for one day, please record 3 days items .
4. If you throw away the items which you marked, record them on the table 2 in 6 page.
5. Record the dishes each meal, and measure percentage of leftover in the table 3 in page 7.
6. On 8th day, measure the marked items which are still remaining on table 4 in page 8.
7. When you throw away the items which is not marked, record on the table 5 in page 8.
8. Fill in the page 9-10 page questionnaires at 8th day.

表1の食品区分別の主な食材です。
これを基に 表1に 記入して下さい

食品区分	主な食材
穀類	ごはん（白飯）、パン類、めん類　など
野菜類	だいこん、ごぼう、れんこん、さといも、はくさい、たけのこ、キャベツ、レタス、たまねぎ、もやし、きゅうり、なす、スイートコーン、そらまめ、えだまめ、じゃがいも、さつまいも、にんじん、ピーマン、トマト、ほうれんそう、ブロッコリー、かぼちゃ など（冷凍品を含む。）
果実類	かんきつ類、りんご、なし、かき、もも、おうとう、ぶどう、メロン、すいか、いちご　など（冷凍品を含む。）
肉類	牛肉、豚肉、鶏肉などの生鮮・冷凍品
卵類	鶏卵、うずら卵などの生鮮卵
牛乳及び乳製品	牛乳、チーズ、バター、ヨーグルト　など
魚介類	魚、貝、いか、たこ、えび、かに　など（冷凍品を含む。）
調理加工食品	調味調理品のびん詰及び缶詰、冷凍調理食品、レトルト食品、豆腐、納豆、ハム、水産練り物 など
飲料類	清酒、ビール、ウイスキー、ワイン、焼酎、炭酸飲料、果汁飲料、コーヒー飲料、茶系飲料　など
その他	でんぷん、豆類（乾燥子実）、きのこ類、生鮮海藻類、砂糖類、油脂類、調味料類及び菓子類
計	穀類、野菜類、果実類、肉類、卵類、牛乳及び乳製品、魚介類、調理加工食品、飲料類及びその他の各食品区分を合計したもの

Table 1 （　　月　　日～　　月　　日）

	First	Second	Third
	Items you bought （g）	Items you bought (g)	Items you bought
grain			
vegitable			
fruit			
meat			
eggs			
and daily products			
sea food			
processed food			
beverage			
other			

Table 2

	second day	third day	fourth day	fifth day	sixth day	seventh day
	Items you throw away(g)	Items you throw away(g)	Items you throw away(g)	Items you throw away(g)	Items you throw away(g)	Items you throw away(g)
grain						
vegitable						
fruit						
meat						
eggs						
milk and daily products						
sea food						
processed food						
beverage						
other						

Table 3 (　　月　　日～　　月 If you throw away food, please put parcentage of the total dish

	the first day		the second day		the third day		the fourth day		the fifth day		the sixth day		the seventh day	
	menu	leftover (%)	料理名	食べ残し (%)	料理名	食べ残し (%)	料理名	食べ残し (%)	料理名	食べ残し (%)	料理名	食べ残し (%)	料理名	食べ残し (%)
例	rice	20%	ご飯	20%	ご飯	0%	ご飯	20%	ご飯	20%	ご飯	20%	ご飯	20%
	natto	10%	鮭	10%	納豆	10%	納豆	10%	鮭	10%	納豆	10%	納豆	10%
	salad	0%	サラダ	0%	お味噌汁	10%	サラダ	0%	お味噌汁	0%	サラダ	0%	サラダ	0%
breakfast														
lunch														
dinner														
snack														

Table 3

Weigh the remaining food in the eighth day

		eighth day remaining
grain	野菜類	
vegitable	調理加工食品	
fruit	穀類	
meat	牛乳・乳製品	
eggs	果実類	
milk and daily products	肉類	
sea food	卵類	
processed food	魚介類	
beverage	飲料類	
other	その他	

Table 4

If you have any throw away food items during this survey except the item with seals, fill in the weight or number

food material name	the throw away food items without using
For example) Onions	two