

## **Abstract**

Food is one of the human survival requirements. Even though world food production can yield sufficient for the global population currently, the hunger population is still very large. The global population continues to expand from 7 billion now to an expected 10 billion in 2100. Additionally, climate change challenges global food production. Thus, feeding the growing population is an urgent problem to be solved. Food safety, food politics and food for producing energy should be taken into account to find solutions for feeding current and future populations. From a psychological perspective, influencing individual attitudes can be a good strategy to contribute to solving global food issues. This thesis aimed at taking an overall look at the food management (FM) situation in an attempt to contribute to a better, i.e. sustainable, future food situation. This was done by reviews of literature related to the world food situation, FM development and regulation, and the connection between the described situation and individuals' attitudes.

A pilot study was conducted in 2010 to investigate attitudes towards taking away food leftovers from restaurants. The sample in the study was a convenient sample of students from the Norwegian University of Science and Technology. A self-completion questionnaire survey was applied to collect the data of the samples' attitudes and of the relationships between such attitudes and various predictors. Stepwise regression was used to test to what degree the predictors explained variance in the general attitude to food waste, and to food waste generated in expensive as well as not so expensive restaurants. The results showed that social norms, personal norms and frequency of experience contributed to explain a smaller fact of the variance in the attitudes. In addition, t-tests were used to compare both the Norwegian and non Norwegian groups of students, and between gender groups. The only difference in the attitudes showed between Norwegian and non Norwegian groups. This pilot

study could give some indications for other future studies working with possible strategies to manage global food waste issues.

The discussion focuses on dilemmas related to the food situation involving food production and distribution, use and misuse, and the challenges related to food management and sustainability.

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# 1 Introduction

## 1.1 Area of Interest

Why do we need to manage the food resource better? The global population reached 6.89 billion at the end of 2010 (PRB, 2010). The Food and Agriculture Organization of United Nations (FAO) reported that approximately 925 million (i.e. 0.925 billion) of the world's population suffer hunger<sup>1</sup> and are undernourished (FAO, 2010). Conversely, in some of the industrialised countries, the part of the population that is overweight is becoming larger and larger. The World Health Organization (WHO) estimated that there were 1.5 billion overweight adults across the world in 2008. This ironic dilemma shows one aspect of the imbalanced distribution and use of the food resource. This comparison presents a false image that we have sufficient food resources to feed everyone on earth. A similarly false image is produced when the food resource is used for other purposes such as producing biofuels rather than human sustenance for survival. On the other hand, a large amount of the food resource is wasted and never consumed, because of date expiry, handling mismanagement, over-serving of portions, or for other reasons. Wasting food does not adhere to humanistic standards although there are large hunger populations.

The hunger issue has been consistently highlighted for more than three decades and has not yet been eliminated. The United Nations (2011) has predicted that the global population will reach 9.3 billion by 2050 and 10.1 billion by 2100. This bigger population implies higher demands for an increased food resource in the future. The part of the world population that is defined as undernourished may be expected to increase as the population expands, unless food production hugely increases the food resource and is developed under comprehensive and sustainable management. Furthermore, in the last thirty years, human society has experienced incidents of food shortage because of various factors such as animal diseases (e.g. mad cow

disease causing shortage of beef meat and H5N1 virus causing chicken meat shortage) (FAO 1999 ). It makes us realise the importance of food safety for insuring a clean and toxin-free food resource. Nowadays, climate change has certain influences on human societal development (IPCC AR4 WG2, 2007). Extreme weather and temperature can ruffle agricultural systems and may ruin a season of food production. At least under current agricultural technology, the production of the food resource has a heavy dependence on climate. The goal of sustainable agriculture certainly demands sustainable management for its accomplishment. To sum up, a better management of the food resource requires *the balancing the food resource distribution and adherence to the purpose of the true value of the food resource (i.e. as human nutrition), diminishing avoidable food waste, and achieving higher demands of food quantity and safety in order to achieve a sustainable human future.*

Furthermore, from a psychological perspective, attitude can be an indicator of how a human behaves toward food, because attitude can be assumed to influence the attitude-related behaviour to some extent (Ajzen & Fishbein, 2005). Attitude can be influenced by social norms (Prislin & Wood, 2005), personal norms (Ajzen, 1991), knowledge (Toh & Bircheough, 2000) and experiences (Thørgensen 2002). Thus in order to change the food situation towards greater sustainability, it seems relevant to understand human attitudes and their predictors. Gustavsson et al (2011) suggested changing attitudes could assist in reducing global food waste. Jensen and Sand øe (2002) implied that understanding attitudes towards food safety could help to establish strategies for practising food safety. Hence, to investigate attitude and to discover its possible contributors could be of interest in the forming of management strategies for issues such as food waste or food safety.

## 1.2 What is food for humans?

Food and humans are inseparable. Food provides human nutrition for survival. Hence, food can be seen as nutrition. Carbohydrates, dietary fibre, fats, minerals, protein, vitamins, and water are the main nutrients that humans require for survival. Food should contain one or more of the required nutrients. Furthermore, if we merely require nutrients, concentrated nutrition pills could be called food. Indeed, we do not consider nutrition pills to be food. This is because food is more than just nutrients.

Sweetness, bitterness, sourness, saltiness and savouriness are the tastes that humans prefer and apply to distinguish food preferences. We can experience sweet taste from fruit such watermelon, bitter taste from beer, sourness from kiwi, saltiness from seaweed and savouriness from soybean. Combining different foodstuffs can create new tastes or highlight a particular taste. For instance, pizza is a good combination of different tastes. The Japanese will put some salt on watermelon to highlight the sweetness before eating. In short, food offers various experiences of taste to humans, and such experiences add a certain quality to the concept of food.

Moreover, food intake frequently involves either or both habitual behaviours: eating and drinking. Kiwi, as an example, is an organic substance rich in the nutrient vitamin-C. If one has never eaten kiwi or has no knowledge about kiwi, the fruit would simply be an unknown substance. On the contrary, when someone starts eating a kiwi, it may be identified as food to him or her. From an individual perspective, if the one has a positive preference towards kiwi and continues eating it throughout a lifetime, kiwi is likely to be recognised as food by that person. In contrast, if one dislikes kiwi or has an allergy reaction from it, then kiwi may not be considered as food. We devote our eating and drinking behaviours to food, especially the food we prefer, no matter whether we live to eat or eat to live, or both.

Food is a resource for humans to diminish the sensation of hunger, to achieve the sensation of fullness and to meliorate the status of undernourishment. Murray and Vickers (2009) reported four stages of food amount consumption in relation to mental well being and physical satisfaction. For instance, mentally, humans can experience states ranging from extreme to light hunger and to light and extreme fullness. One can apply the same type of distinction to physical satisfaction. However, people could consume non food substances to become physically full, but could not reach “mental fullness” without real food. An empty stomach can certainly be filled up with other non food substances such as cotton and drugs in order to diminish hunger. However, based on the health perspective, food should be the only appropriate means to do so.

In brief, food is any edible or drinkable nutrient substance that requires behaviours of eating and/or drinking. It provides taste experiences and can satisfy the physical needs of survival and well-being.

### **1.3 The big picture**

Human beings participate in different cycle systems. The relation between food resources, climate change and humans can be seen as one of these cycle systems. There are two main direct perspectives to understand the cycle system (Figure 1). The first direction starts with the human being. He or she requires food resources to provide nutrition for survival. There is a sustainable approach (e.g. environmentally friendly agriculture) and an unsustainable approach (e.g. non environmentally friendly agriculture) to gain and manage resources. Each approach creates a different impact on the environment and climate: a less negative impact with the sustainable approach (e.g. less pollution and carbon dioxide emission) and a negative impact with the unsustainable approach (e.g. more pollution and carbon dioxide emission). Eventually, a changing climate, because of these impacts, will

influence the living conditions of humans. For example, a positively changing climate can

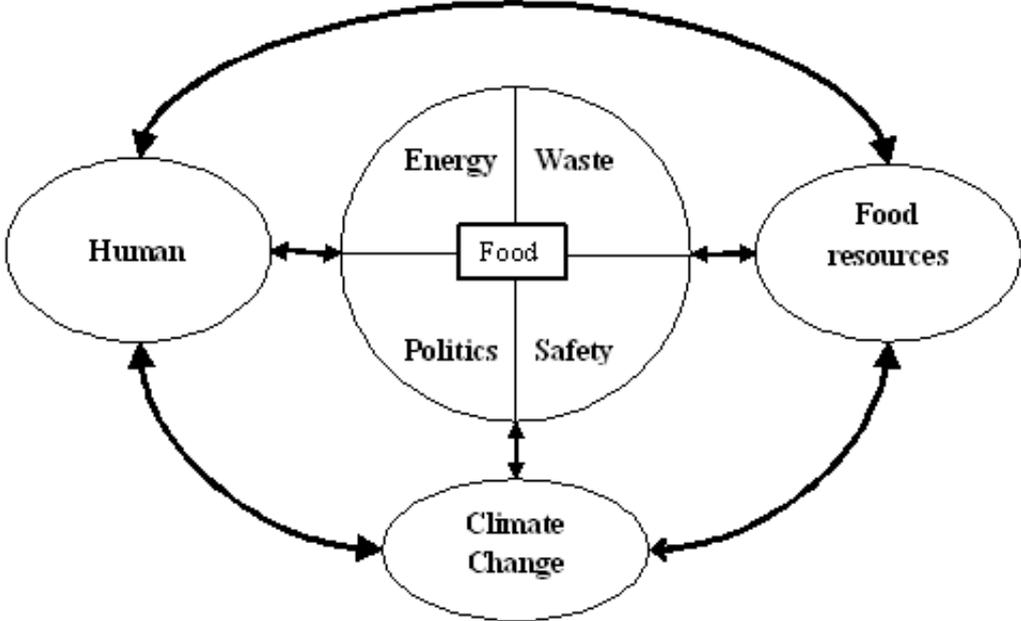


Figure 1. The relationships between human, food issues (the central circle), food resources and climate change

lead to an environment that lacks extreme conditions such as extreme temperature, floods or drought. Humans would have better living conditions in a balanced environment than in an imbalanced environment with the extreme conditions.

The second direction affects humans as well. If the human species do not treat the natural environment respectfully and continue to develop civilisation unsustainably, without due consideration of the natural environment, the environment will worsen and the security of food resources will be threatened. In the end, the severed food resources would cause situations of hunger or undernourishment that would jeopardise human survival.

There are four food related aspects within the cycle system. Energy and waste from food can be manipulated with different types of management (i.e. sustainable and unsustainable) and can impact on the relationship between humans, food resources, and climate. Therefore, politics and safety related to food management can affect the relationship

between sustainable and unsustainable approaches. As can be seen in Figure 1, the food issues are in the centre of the figure to illustrate their core importance to energy, waste, politics, and safety.

#### **1.4 When food is food**

This subsection describes the relationship between humans and food when humans appreciate food as food itself.

##### *1.4.1 We love it*

There seems to be no other species on earth that loves food more than humans do. Humans have created hundreds and thousands of various dishes from recipes for food and this process of creation is still growing. What ingredients to use, how to prepare the ingredients, how to cook, and length of time needed to cook are presented together in a recipe. It is similar to the process in a chemistry laboratory that combines chemical compounds to formulate new chemical products. Frying, boiling, roasting, steaming, broiling, and other cooking methods are applied to highlight flavours in food. A single food ingredient can be brought out to serve various tastes by cooking with different methods. Salmon fish as an example can be roasted in oven to taste it in an unadulterated 'whole' form or can be smoked to keep the original raw fish flavour and texture .

Food recipes can reflect human cultural characteristics (i.e. learned, shared, based on symbols, integrated and dynamic), eating habits, and the knowledge that leads to food resource choices. Every culture has its own recipes. When we think about Japanese food, sushi is usually the highlight; when we discuss Italian food, pizza and pasta are usually associated with the country. Some cultural foodstuffs tend to be spicy like Mexican; some tend to keep the food's original taste, like Cantonese food from southern China. We love

food not only because it can promote our physical survival but also because it can satisfy our social and mental wellbeing.

#### *1.4.2 We want it and cannot have it*

In the current situation of food resource distribution, not everyone on earth has accessibility to the food resource or sometimes there is no available food resource to access. In situations where a population often experiences inaccessibility to food resources and this lack of access persists for a period, hunger and undernourishment will be the result. According to an FAO report (2010), more than 920 million people are currently trapped in a situation of hunger and undernourishment. The causes of hunger are various. Natural disasters and climate change, war and conflict, poverty, harmful economic systems, inadequate agricultural infrastructure, and inconsiderate management of agricultural production are the currently acknowledged causes of hunger (WFP, 2011; World Hunger Education Service, 2011).

Poverty is an essential cause of the hunger situation. Because of poverty, the undernourished population does not have the means to purchase food. Because of poverty, this population has no strength to defend itself from the consequences of natural disasters and financial crisis. Because of poverty, the hunger population does not have resources to gain education to change unsustainable agricultural practices and to adapt to climate change. Because of poverty, the hunger population is unable to develop an agricultural infrastructure to establish sustainable farming. Everything occurs for a reason. The poverty situation can be caused by natural disasters, war, or conflict. Poverty itself can also become a self-perpetuating trap (WFP, 2011; World Hunger Education Service, 2011). The poor do not have money to purchase food, which in turn leads to a weakened agricultural labour force. The result of a weakening of the agricultural labour force can be lower farm production. The lower production represents less agricultural products and less income that can be gained from

trade. Less income can pay for smaller amounts of food. The process repeats itself and the poor become trapped into a poverty cycle. Therefore, the hungry people want food and they cannot have it.

## **1.5 When food is not food**

This subsection focuses on the relationship between humans and food resources where humans do not appreciate or use food as food for themselves. Food resources are used for other purposes than nourishing humans for survival.

### *1.5.1 It is for producing energy*

Biofuel was discovered to be a potential substitute for certain petroleum products, such as natural gas and diesel. However, the feedstock of biofuels comes from various domains and depends on the type of biofuel (i.e. first generation, second generation, and third generation). The first generation biofuel requires seeds (e.g. sunflower seeds), grains (e.g. corn), animal fat, and oil plants (e.g. oil palm), which are food resources, used as the feedstock. The production of second generation biofuel consumes waste biomass, the stalks of wheat, corn stover, or wood as feedstock. The third generation biofuel is known as algae fuel and algae are the feedstock. The second and third generation biofuels do not require food resources as feedstock. However, only the first generation biofuel currently has commercial possibilities; the second and third generation biofuels are under development and need to breach certain technological barriers to be profitable (IEA, 2008; Milledge, 2010). Hence, the first generation biofuel will still be the only commercially viable application until the advanced biofuel has been further developed. In other words, food resources are utilised for production of biofuel instead of feeding humanity.

The utilisation of food resources as biofuel feedstock might lead to a negative cycle and create negative impact on human living conditions such as the economy. For instance, when sugar cane prices increase, this also triggers the cost of the biofuel feedstock to increase. Consequently, the finished-goods price of biofuels would also have to be increased in order to be profitable. This cost may end up being transferred to consumers.

### *1.5.2 It becomes waste*

When something becomes waste, it means the object is useless or undesirable in relation to its main functional purpose to users. Hence, when food becomes waste, food waste becomes useless or undesirable for eating or drinking to consumers. There are reasons that food becomes waste. It might be that one cannot finish a carton of milk before its expiry date and the milk becomes waste. In addition, it might be that one orders too much in a restaurant, is not able to eat it all, and the leftover food becomes waste. Otherwise, it might be that the food does not match to eater's sense of taste, leading them to cease consuming it and, therefore, the disliked food becomes waste.

According to a report from Quested and Johnson (2009), UK households produce approximately 8.3 million tonnes of food and drink waste per year. This means that each UK household generates about 330 kg per year or around 6 kg per week. The report also demonstrated that 5.3 million tonnes of the total food waste was avoidable. The avoidable food waste included food that had not been consumed before it expired possibly as a result of purchasing an excessive amount. Additionally, the remaining 3 million tonnes consisted of two types of food waste, one of which was possibly avoidable (e.g. if someone eats and others do not or as a result of incorrect cooking methods) and the other type was unavoidable (e.g. parts of food cannot be processed by humans, such as eggshell and meat bones). The report estimated the possibly avoidable food waste to be 1.5 million tonnes. As a result, avoidable and possibly avoidable food waste together accounted for more than 80% of the total amount

of food waste. Furthermore, the amount of avoidable food waste was worth 12 billion British pounds based on retail prices. When divided per household, the cost was 480 British pounds (Quested & Johnson, 2009). Nevertheless, the WRAP report merely focused on household food waste. Twelve billion British pounds was the tip of the iceberg in the cost of food waste. In addition, there is food waste not counted from other areas such as industry, transport and storage, retail, and catering services. In brief, wasting food is costly for individual consumers, and for industry as well as for the nation.

### *1.5.3 It is a political tool*

In the last century, global food production has been heavily industrialised. The food industry has taken control of what we eat. For example, colourful packages wrap up food products; TV advertisements tantalise consumers with enchanting food images; nutritional labels intend to display the ‘healthy’ side of products. In fact, food additive chemicals intermingle with our food more than ever. The ‘low-price food’ trap displays unrealistic images to strengthen consumer behaviours. The food industry’s desire for profit and power provokes consumers to eat more. In some countries, agricultural subsidies may represent a critical relationship between farmers and their government’s policy. Food is not just food; it becomes a political tool. This tool may maximise profits for both the food industry and the state.

Since the times of Egyptian pharaoh governance, food has been a political tool, traditionally reflected in taxation. One fifth of all revenues from farmers from food production were collected as tax, according to the Bible book of Genesis (chapter 47, verse 24). In addition, a similar food taxation system occurred in historic times in China before currency was invented.

According to a report from the Institute for Agriculture and Trade Policy (Schoonover & Muller, 2006), U.S. Farm Policy did not develop a healthy-diet market platform for

consumers and this resulted in the proportionally larger average body-size of the nation that we see today. Particular farm products such as corn (needed for producing sugar substitute) and soybeans (for producing vegetable oil) were promoted for overproduction in order to maintain low prices and to keep the food industry earning high profits (Elinder, 2005). Accordingly, food can be political tool.

#### *1.5.4 It becomes poison*

From the early times of human civilisation, we recognised that bad food could cause illness. In 1963, *Codex Alimentarius*, which is an international ‘food book’ containing related information on all known types of food, was created by the FAO together with the WHO. Humans have a long history of identifying safe food for the daily meal. The process of managing food safety will continue with the development of human civilisation.

We consume food every day. If the food is not treated and prepared safely, the risk of food poisoning becomes much greater. Food poisoning can cause a variety of illnesses from minor pain in the stomach to death. Food safety is a necessary safeguard for our food resource and also to protect us against food poisoning. There are many more reasons that we should have comprehensive and accurate food safety management involving education, policy, and regulation. A sprouted potato can be poisonous if a person eats it without proper cooking treatment. Consuming shellfish and alcohol at the same time can possibly create serious stomach pain and vomiting. Consuming leftover food without properly reheating it can also render it poisonous. Animal disease can contaminate meat. Additionally, food additives require extra monitoring in order not to transfer poison into food, because such overdosing or misusing of chemicals can cause serious negative impacts to health. From thoughtless cooking methods to misuse of food additives, food can become poisonous via any irresponsible process.

In 2008, the Chinese milk industry became a public enemy in China. This was because melamine (a nitrogen-based organic chemical) was misused by the milk industry as a food additive and was blended into milk powder to increase the protein content, in order to reach nutritional criteria. As the result of consuming the poisoned milk powder, six infants died, and 52.000 children were hospitalised. The serious damage had a wide impact on milk consumers and additionally around 250.000 children were affected by kidney disease and urinary problems because of the poisoned milk. The resulting medical treatments billed to the health system were estimated at 58 million Euros. The cost for follow-up treatments was huge and continued to increase. An article from Pei et al. (2011) suggested that the event was caused by two main factors in food safety management: “... *the first was melamine was not specifically listed as an illegal additive. The second was that many dairy giants in China ... were exempted from official controls.*” The official controls involved a series of milk quality tests (e.g. measuring nutrient content). The article (Pei, et al., 2011) also pointed out that the quality tests did not function effectively and accurately. The event triggered a re-evaluation of Chinese food safety systems, including food safety management, policy, and regulation.

Furthermore, the Chinese milk incident was not the only serious food safety incident. Foodborne illness outbreaks occur continuously around the world including food diseases transferred from animals, such as mad cow disease and bird flu. To reduce the risk of food poisoning one needs to go back to the origin of the food resource (i.e. farming and animal welfare), and the process must be followed up until the moment when we put the food in our mouth. The article summarises that food safety management is the protection against food becoming poison.

## **1.6 Challenges with implications for food**

This subsection emphasises the relationship between climate change and food resources and the influence of the human population on the food resource.

### *1.6.1 Climate change*

Climate change is “*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*” (United Nations, 1992, p.4). Climate change is happening and has already had an impact on our modern human life (IPCC AR4 WG2, 2007). This impact is a potential risk to our food resource domains, which are agriculture, forestry, and fisheries. The area of agriculture appears to be the most defenceless, because most of our agricultural methods are climate-based and dependent. Flitner and Herbeck (2009) reported that climate change had primary effects of increasing atmospheric CO<sub>2</sub>-levels, rising temperatures, changes in precipitation patterns, sea level rise, increasing frequency and intensity of extreme weather events, ocean acidification, and changes in oceanic current regimes. Sea level rise can limit the land size on earth that humans need, and result in humans having to live in a more crowded space. Rising temperatures can lead to water shortage and storage issues, which include an increasing difficulty in finding water. Increasing frequency and intensity of extreme weather events like flooding and storms can destroy human living areas, such as in the hurricane season in Florida, USA. If we do not have the ability to resist and endure extreme weather events (such as flood and storm) in the farming areas, for example, the farms and agricultural products may be prone to serious ruin which may in turn lead to food shortage.

Under the current circumstances of climate change, it may be more difficult and more time consuming to adjust the climate than to adapt to it. However, this does not signify that

climate adjustment is not a necessity. In spite of everything, humans need food to survive. The issue is how to secure the food resource under climate change. To secure food is to provide enough food, to retain safe food, and to maintain the nutritious value of food.

First, agriculture should adapt to the change of climate to produce sufficient and nutritious food. Most agricultural farming methods depend on a steady and stable climate. FAO (2007) pointed to autonomous and planned adaptation with respect to agriculture in climate change. Autonomous adaptation focuses on the farming level. It requires farmers to adjust seeding-harvesting patterns and to alter farming products. On the other hand, planned adaptation focuses on the policy level and proposes to adjust the agricultural system with assistance of policy adaptation and adaptive capacity. It can assist farmers with crop selection and farming tactics across different regions, such as possible replacement of crops (Easterling, 1996).

Furthermore, a changing climate can provide challenges for food safety as crops must interact with unstable environmental conditions (e.g. weather, temperature and humidity). Foodborne diseases, animal diseases, chemical contaminants in the environment, and emergency disaster related situations could all have a potential impact on food safety as an effect of climate change (Jaykus, Clarke & Friel, 2008). Weather, as an example of an unstable environmental condition, influenced by the changing climate, has a major impact on outbreaks of transferable diseases (i.e. foodborne diseases and animal diseases) (Epstein, 2001). If the food is infected and is therefore destroyed in order to prevent the outbreak, it could cause food shortage and can have effects on food insecurity. Hence, the relationship between food safety and climate change is not only about avoiding food being poisoned and polluted, which can be triggered by climate change, but is also about maintaining food levels by retaining it safe at all stages of the food chain.

The changing climate can negatively exacerbate global food production and safety, if we do not act quickly and effectively with sustainable strategies from individual farmer level to governmental level. Subsequently, if we fail, hunger will become more widespread than now.

### *1.6.2 Population*

Earth is, as we know, the only one planet we can live on currently. However, the resources on this planet have limitations. The food resource is like a cake that is shared with others. More people come to share and therefore smaller portions are available to individuals. A larger population demands a higher quantity of food resource. We have not found an external supplier planet. The interaction between population and food is both direct and indirect. The direct relationship reflects simply that a larger population consumes a larger amount of food. A larger population requires more land to live on, which may, therefore, reduce the agricultural land area. A larger population consumes more water, which may cause water shortage for food production. A larger population creates more environmental issues that can lead to less resources and greater pollution affecting food production (Chandrappa & Ravi, 2009). Along with the development of agricultural technology, food production can be increased to supply the higher demands of a bigger population. Even if the agricultural technology is advanced enough to feed 9 billion people by 2050, a greater population is more likely to put heavy pressure on, and burden, the eco-system and the planet.

China and India are two illustrative examples that epitomise the need to clarify the global challenges of food-population relationships. The two countries together hold approximately one third of the global population (China with 1.34 billion and India with 1.22 billion) (United Nations, 2011), and have about one third (estimated 129.6million in China and 224.6 million in India) of the total global hunger population (FAO, 2010). The land size of China is about three times bigger than India. According to FAO (2010), China was

progressing well towards the Millennium Development Goal 1 (i.e. MDG1 to halve the undernourished population between 1990 and 2015) with India showing no progress towards the MDG1. Two countries with large populations and limited living capacity displayed two different results on the task of diminishing hunger. China has a restrictive population control policy, which is a one-child policy. In contrast, India has a loose and voluntary population control which has a “we two, ours one” slogan meaning two children per family. Indeed, the suggested population control in India does not appear to be effective. With the total populations of these two countries being equally large, despite their geographical difference in size, a smaller population density may have more advantage to provoke a change on the hunger issue. In a situation with two same low-income families, the family with only one child will use less income for feeding everyone than a family with three children. Without the one-child policy, China’s impact on the planet might be 300 million more people to feed, which might well obstruct economic development. As a result, more poverty might appear and lead to a bigger hunger population. China, with its restrictive population control managed to reduce the hunger population to 129.6 million (ca. 10% of total population) approaching MDG1. In contrast, India, with a less strict and voluntary population control, failed to progress toward MDG1.

The courses of action regarding population growth alongside the hunger issue from these two countries can act as a source of reference to clarify the relationship between large populations with different population policy and the hunger issue. Why do we have to keep improving production to feed more population instead of accepting the fact we are unable to feed more people?

## 1.7 Food situation in Norway

According to Statistics Norway (SSB, 2010), the degree of self-sufficiency from agriculture in Norway was at about fifty percent in 2010. In other words, if Norway does not import food products from other countries, Norwegian agriculture can only satisfy half of the food demand of the Norwegian population. Several agricultural products such as meat, cheese and eggs are being supplied domestically at an adequate level to supply the nation; other agricultural products (e.g. fruit, vegetable, sugar and berries) rely on importation (Flaten & Hisano, 2007). However, the lack of certain agricultural products is recovered by the global trading market. Food security in Norway seems to be achieved in this way. The concept of food security in a developed country is different from that of a developing country, which is defined as *“all citizens in a country have access to enough and healthy food in crises, nationally or internationally”* (Flaten, 1999). Therefore, the present status of the food supply security in Norway does not reflect on the status of food security when crises occur.

Moreover, *“about 335000 tons or 25 % of all food being produced in Norway ends as food waste ... the largest volumes of food waste are found with fruit, vegetables and bakery products.”* (Nofima, 2012). The statement addressed only the food waste from the food industry and retailers. There can also be a hidden amount of food waste from households and the food service industry. Norway as a fruit and vegetable importing country creates a large amount of food waste from fruit and vegetables. Norwegians, however, both demand the fruit and vegetables, and waste them at the same time. This incongruous situation causes negative consequences on finances and the environment. Prevention of food waste is an approach to adjusting the situation. It can be also a positive approach towards food security and the negative consequences in that respect. As shown by the incongruous situation, food resource management in Norway has to improve with the purpose of adjusting the incongruity

## **1.8 Research interest of the pilot study**

The consumer food waste from restaurants is huge. However, based on personal observations, it appears that taking away food leftovers is not a usual phenomenon in Norway. Why do people often take away food leftovers from restaurants in Norway? What attitude do Norwegians have towards taking away leftover food from restaurants? How is the attitude towards taking away leftover food constructed? Is there a way to influence people to use a 'doggy bag' in order to reduce food waste in restaurants?

## 2 Theoretical background

### 2.1 Food security management

#### 2.1.1 What is food security?

The 1996 World Food Summit defines food security as “*when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life*” (WHO, 2012). Food security contains four key components: food availability, food access, food utilisation, and food stability. Food availability refers to the necessary amount or quantities of food resources being available and consistently sufficient for users. For instance, if an individual has an amount of food for weekly consumption at home, the food availability to the individual can be considered as achieved. When food resources are available, they need to be able to be accessed by users in order to achieve food security. Hence, it brings to us the second component – food access. Food access is associated with the various and adequate types of food resources that can be obtained to establish a nutritionally adequate diet. Rice and potatoes alone are not enough to form an adequately nutritious diet, other food resources such as fish, meats, vegetables and other foods are required to achieve optimal nutrition. Besides having access to a sufficient amount of various food resources, how to consume food is important in food security, and makes up the third component – food utilisation. Food utilisation indicates that an appropriate consumption of food resources is based on knowledge of nutrition and health. It implies that individuals should eat only a certain amount of meat and should not over consume to achieve their energy requirement for daily life. Finally, food stability refers to the food security definition “all people at all times.” It specifies the extent of food security that comprises the amount of recipients and the length of time involved. To

define food security is simple: it means that the four requirements are fulfilled. However, it is difficult to achieve food security, fulfilling all the components all the time.

### *2.1.2 Guidelines for food security management*

Food security management focuses on hunger prevention from both a short- and long-term perspective. The five Rome principles for sustainable global food security (FAO, 2009, pp. 2-6) introduced as a strategic framework of food security:

- 1. Invest in country-owned plans, aimed at channelling resources to well-designed and results-based programmes and partnerships.*
- 2. Foster strategic coordination at national, regional, and global level to improve governance, promote better allocation of resources, avoid duplication of efforts, and identify response gaps.*
- 3. Strive for a comprehensive twin-track approach to food security that consists of: 1) direct action to immediately tackle hunger for the most vulnerable; and 2) medium-and long-term sustainable agriculture, food security, nutrition, and rural development programmes to eliminate the root causes of hunger and poverty, including the progressive realisation of the right to adequate food.*
- 4. Ensure a strong role for the multilateral system by sustained improvements in efficiency, responsiveness, coordination, and the effectiveness of multilateral institutions.*
- 5. Ensure sustained and substantial commitment by all partners to investment in agriculture and food and nutrition security, with the provision of necessary resources in a timely and reliable fashion, aimed at multi-year plans and programmes.*

The five Rome principles provide a guideline for nation-based strategies and implementation of food security. The principles cover planning, coordination, problem approaching, collaborating and making it obligatory that food security strategies should be included. Besides the national-orientated guideline, FAO in 2000 proposed guideline strategies for corporations, which included:

1. *Reducing food insecurity and rural poverty (p. 6)*
2. *Ensuring enabling policy and regulatory frameworks for food, agriculture, fisheries and forestry (p. 9)*
3. *Creating sustainable increases in the supply and availability of agricultural, fishery and forest products (p. 11)*
4. *Conserving and enhancing sustainable use of the natural resource base (p. 14)*
5. *Generating knowledge of food and agriculture, fisheries and forestry (p. 16)*

Each strategy has sub-strategies that suggest corporate directions and focus on food security (FAO 2000, pp. 6-18). FAO (2000) also emphasised two essential sources, interdisciplinarity and partnership, in order to have a comprehensive and effective implementation.

Interdisciplinarity means to approach food security issues with relevant and various disciplinary knowledge fields and expertise, and partnership means to collaborate with different organisations on different governance levels (e.g. UN or a local community).

Therefore, when a corporation approaches food insecurity issues, it should collaborate with various organisations, both governmental and non governmental, to obtain diverse relevant disciplinary expertise.

### *2.1.3 The associations with food insecurity*

Food insecurity has polarised consequences in developing and developed countries. On the one hand, food insecurity can lead to hunger and malnourishment (FAO 2011); on the other hand, being overweight and obesity can be associated to food insecurity (e.g. Townsend et al, 2001; Adams, 2003). Cook and his colleagues (2004) concluded in their research that food insecurity affecting infant health in the US was accompanied by an increasing need for hospitalisation. In addition, research by Seligman, Laraia, and Kushel (2010) showed that adults who suffered food insecurity had an increased risk of developing a chronic disease (e.g. hypertension, hyperlipidemia, and diabetes). On a bigger scale as a result of the food insecurity effect, human development could be obstructed (Hamelin, Habicht & Beaudry, 1999). After a decade of Hamelin et al's research, the differences in human development across different regions seems to show evidence that can be associated with how much the issue of food insecurity is an influence. Western Europe, China and Africa can be seen as representing three types of relationships between human social development and food insecurity, e.g. a rather high and low security situation in Europe and Africa, respectively, with China in between.

## **2.2 Food safety management**

### *2.2.1 What is a food safety management system?*

Food safety is defined as when the food does not cause health issues to humans and animals because of foodborne illness (WHO, 2007). Hence, managing food safety is to ensure that the risk of food causing harm to humans and animals is reduced to a minimum. The aim is to manage the processes and procedures of treating food in the food chain from

production to consumption, with the purpose of assuring food safety for human and animal consumption

A food safety management system (FSMS) is a form of standard for food safety management that includes broad domains of performing food safety, for example, guidelines and regulations, risk analysis, program and procedure, communication, roles and responsibilities, and other aspects related to food safety (ISO 22000, 2005, 2005). The system directs how food safety management is to be done. There are six key elements in a FSMS reflecting the food safety performance: management system, prerequisite programmes (e.g. Good Agricultural Practices, Good Manufacturing Practices, Good Storage Practices and Good Hygienic Practices), Hazard Analysis and Critical Control Point (aka HACCP), validation and verification, emergency preparedness / crisis management, and quality management (Mensah & Julien, 2011). The British Retail Consortium's global food safety standard (BRC), the International Food Standard (IFS), ISO 22000, and the Safety Quality Food (SQF) are often-used FSMSs internationally. The difference between these FSMSs is whether they include emergency preparedness and/or quality management (Mensah & Julien, 2011).

### *2.2.2 HACCP and its application*

Hazard Analysis and Critical Control Point is the core element in the common FSMSs. It is a methodical and science-based tool that aims to identify, measure and control the hazards that cause foodborne illness, in order to guarantee food safety (FAO 1998). The essence of HACCP is its seven principles. The seven principles are (FAO, 2001):

- 1. Conduct hazard analysis (p. 29)*
- 2. Determine the Critical Control Point (CCP) (p. 29)*
- 3. Establish critical limits (p. 29)*
- 4. Establish a monitoring system (p. 29)*

5. *Establish a procedure for corrective action, when monitoring at a CCP indicates a deviation from an established critical limit (p. 29).*
6. *Establish procedures for verification to confirm the effectiveness of the HACCP plan (p. 30).*
7. *Establish documentation concerning all procedures and records appropriate to these principles and their application (p. 30).*

Principle 1 aims to ascertain the identification of hazards at all stages from production to consumption, to measure the probability of hazard occurrence, and ascertain barriers of preventative controls. Principle 2 specifies the control point at all the stages that can be manipulated to reduce the risk of hazards. In Principle 3, acceptable risk level limits are required for each CCP to select which hazard needs risk reduction to acceptable risk level. After the previous three principles, a safety check system, with a monitoring system, is needed to ensure that the purpose of the previous principles is correctly achieved. Principle 4 includes observation, measurement, recording, and evaluation procedures. Principle 5 requests a back-up safety procedure that manages restorative action when a monitored CCP is indicating unacceptable values. It intends to prevent unsafe food products from reaching consumers. Principle 6 involves auditing, that is to review the implemented action of the HACCP plan to assess whether it achieves the goal of the plan. Lastly, Principle 7 requires documentation of the HACCP results for the purpose of review, inspection, investigation, verification and so on. All seven principles encompass the guidelines of how HACCP should be applied in reality.

Moreover, the application of HACCP in practice requires not only the seven principles but also five more tasks (FAO, 2001). The first task is to establish a team that operate HACCP. Next, the team is required to prepare a comprehensive description (i.e. information concerned to safety) of the food product for HACCP (e.g. how the product is packed, stored

and distributed). The third task for the HACCP team is to ascertain how the food product is consumed (e.g. directly, required cooking or other processing). The fourth task is to sketch a flow diagram of the commodity system so that the team has a good overview. In the fifth task, before performing HACCP, the team should perform on-site observation of the production system. The observation ensures the flow diagram represents the product system correctly and accurately.

### 2.2.3 Food safety management for the individual consumer

On the individual consumer level, food safety management is simplified. Five essential key points are promoted by WHO (2006) to ensure safer food, which are:

1. Keep clean
2. Separate raw and cooked
3. Cook thoroughly
4. Keep food at safe temperatures
5. Use safe water and safe raw materials

The first key point, *keep clean*, indicates that all surfaces and equipment that will have contact with food are required to be disinfected. Cleaning of the food is also important. In addition, no insects or animals (e.g. dog, cat, rat etc.) are allowed in the cooking area. Washing hands is always necessary before touching food, when processing food and after going to the toilet.

The second key point, *separate raw and cooked*, implies all that food and equipments (e.g. knives, cutting board and container) should be used, handled and stored separately for raw and cooked food. This is to avoid cross-contamination from raw to cooked food.

The third key point, *cook thoroughly*, specifies that the food should be prepared using the required cooking process, e.g. meat, poultry, eggs and seafood. These types of food

should be cooked until juices are clear and until they do not have a raw-like colour (e.g. pink for meat). The temperature inside the food should also reach seventy degrees Celsius for at least thirty seconds in order to eliminate the most dangerous microorganisms.

The fourth key point, *keep food at safe temperatures*, states that raw, cooked and frozen food can be vulnerable to microorganisms at room temperature (i.e. between 5 and 60 °C). The WHO (2006) says that microorganisms decrease or stop growing below 5 or above 60 °C. They also recommend that cooked food should not stand at room temperature over 2 hours and should be stored and refrigerated with a temperature below 5 °C. Refrigerator storing also applies to perishable food. Refrigerator-stored food must not be kept too long because some dangerous microorganisms can grow below 5 °C. Frozen food should defrost in the refrigerator or a cooling storage to prevent microorganisms from growing rapidly.

The fifth key point, *use safe water and raw materials*, means that only food and water that do not contain a high level (i.e. could lead to illness and/or disease) of microorganisms and toxic chemicals should be used and consumed. In particular, fruits and vegetables should be washed properly before eating raw, and expired food should not be consumed.

## **2.3 Food waste management**

### *2.3.1 What is food waste management (FWM)?*

Waste management (WM) was defined by the European Parliament and the Council (2008) as the “*collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites*” (p.9). Hence, FWM can be understood as a food-material focus of WM in the Europe Council’s definition. Furthermore, Pongracz and Pohjola (2004) presented a different version of WM, “*... is control of waste-related activities with the aim of protecting the environment and human health, and resources conservation*” (p.151). This definition of WM points to the concept of waste activities. Waste activities

include *waste-creating processes, waste handling and waste utilization* (Pongracz & Pohjola, 2004). Therefore, FWM can also be described in the Pongracz and Pohjola's WM's suggestion, although with food waste related activities. However, FWM can be categorised under organic waste management or bio-waste management, which includes garden waste, agricultural by-product waste etc.

Moreover, in the European Council's definition, it involves only waste handling and waste utilisation, which are collection, transport, recovery and disposal. The European Commission embarked on a new waste approach, building on the European Council WM that involves the concept of waste hierarchy (European Parliament & the Council, 2008). The waste hierarchy includes prevention, preparing for reuse, recycling, other recovery (e.g. energy recovery), and disposal. The European Commission provided the official clarification of five approaches in the waste hierarchy (European Parliament & the Council, 2008).

The new waste approaches seem to be covering all the waste activities mentioned in the Pongracz and Pohjola definition. However, in FWM, the waste hierarchy needs to be modified and specified to food waste because the hierarchy can be used for just normal waste management and these aspects are represented as avoid, reduce, reuse, recover, treat and dispose (Kosseva, 2011). These six approaches each have a degree of preference, which ranges from most preferable (i.e. avoid) to least preferable (i.e. dispose) (Figure 2). It implies the effort should focus on preferable approaches (i.e. avoid, reduce, and reuse) rather than non-preferable approaches (i.e. recover, treat, and dispose). The execution of FWM can lead the development of food production and food utilisation to a sustainable process in the sustainable food future (Laufenberg, Knuz & Nystoem, 2003).

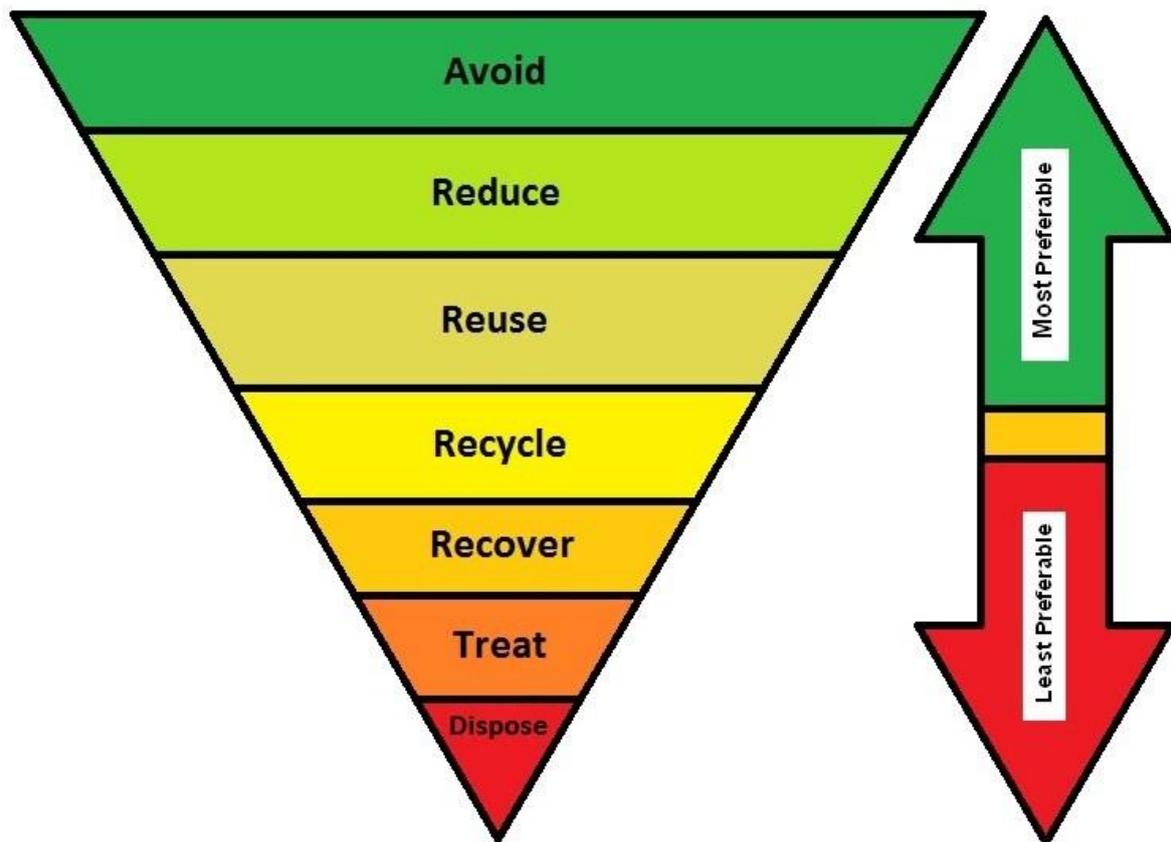


Figure 2. Food waste management hierarchy. Adapted from “Purchasing, Consumption and Waste”, by Moira Shire Council, <http://www.moira.vic.gov.au/>

### 2.3.2 Regulations and guidelines of FWM

Relevant regulations to FWM in Europe are limited and under development. However, the Irish government launched its first FWM regulations in 2009 (S.I. No. 508, 2009). The Irish FWM regulations are aimed at organisations and commercial businesses such as restaurants, the food industry, grocery stores, hotels, the health care sectors, and other sectors where food is produced (S.I. No. 508, 2009). Food waste from households is not included in the regulations. In addition, 50 kg of waste per week is the minimum criterion that obligates a business to follow the regulations. When the business produces more than 50 kg per week, it

is required to separate the food waste from the general waste (S.I. No. 508, 2009, pp13).

Additionally, the regulations include food safety and hygiene standards, and state that food safety and hygiene standards are given priority when in conflict with the regulations.

Moreover, FWM regulations at the level of the European Union (EU) are currently developing. This development was motivated by the benefits of separate collection of bio-waste (e.g. food waste and biodegradable garden waste) from the general waste (ARCADIS, 2009). The act of Green Paper (European Commission, 2008) is the current achievement of EU's FWM regulations. It aims to improve the management of bio-waste. The Green Paper act focuses on environmental impacts, economic impacts and social-health impacts. It highlights the comparison of different WM options between the EU member countries. However, in spite of everything, the EU-level FWM regulations are a long way from being finalised.

In Norway, the FWM regulations are regulated (e.g. FOR-1997-11-27-1518 1998; FOR-1997-11-27-1519, 1998 and FOR-1998-10-01-968, 1995) under the Norwegian Pollution Control Act. These regulations are based on individual municipality level. For example, Trondheim has its own FWM regulation (i.e. FOR-1997-11-27-1518, 1998) and Bergen has its own (i.e. FOR-1997-09-22-1187, 1997), which focus on their own food waste circumstances. Trondheim's food waste regulations put attention on commercial businesses rather than on individual households (FOR-1997-11-27-1518, 1998 and FOR-1997-11-27-1519 §4.). Nevertheless, these regulations (e.g. Trondheim and Bergen's) have similar purposes (in English translation):

- 1. To promote waste minimisation, recycling and reducing the environmental impact of waste management in Trondheim municipality, shall be implemented separately collecting food waste from large households (FOR-1997-11-27-1518, §1, 1998).*

2. *Trondheim municipality aims to reduce waste problems by preventing waste, reducing the amount of hazardous substances in waste, promote reuse, recycling and energy recovery, and to ensure environmentally sound disposal of residual waste. This is in line with national objectives and strategies within the waste sector.( FOR-1997-11-27-1519 §1).*
3. *To promote waste minimisation and reuse, and reduce environmental impact during transportation and at the end of the treatment of waste, organised collection of leftovers from the kitchen shall be implemented (FOR-1997-09-22-1187, §1).*
4. *The regulations shall ensure that food scraps are used for animal feed after sterilisation, or composted if there are economic or other reasons for doing this, and to ensure a hygienic storage, collection and transportation of this waste category(FOR-1997-09-22-1187, §1).*

In Trondheim, in order to achieve the purpose, the regulations also state that large food waste producers (e.g. cafeterias, restaurants and hotels) which generate more than 35 kg per week are required to make a separate collection for food waste (FOR-1997-11-27-1519 §4.). Furthermore, not all municipalities are separating food waste in their waste management plans, even if they have the FWM regulations (Refsgaard and Magnussen, 2009).

### *2.3.3 The directions of implementation of food waste management*

The food waste hierarchy provides six stages (i.e. avoid, reduce, reuse, recover, treat and dispose) that provide a good approach to set up FWM. In the first and second stages (i.e. avoid and reduce), it is important to understand the individual's attitudes and preferences towards food waste (Purcell & Magette, 2010) in order to create compliance behaviours. This can facilitate for policy maker to establish relevant policy and regulation towards better FWM. Furthermore, the reuse and recover stages focus on the food waste as raw material sources for production of other products, such as biogases (e.g. El-Mashad & Zhang, 2010)

and hydrogen (e.g. Shin & Youn, 2005). At last, if all previous stages have failed to perform the stages of treat and dispose are the only options available, like land filling and incineration. Such incineration as treatment of food waste requires extra energy consumption (e.g. transportation) and the burning can release an extra amount of greenhouse gas. From the first stage to the last stage, this hierarchy simply represents the ideas from prevention to handling and destruction.

These last three sections deal with food security, safety and waste management. In the following, a very short outline of the central concept of attitude, social and personal norms will be presented. Thus learning the food situation framework and going into the individual realm.

## **2.4 Attitude**

This section aims to illuminate briefly what attitude is, how it is defined, and how attitude is structured and measured.

### *2.4.1 What is an attitude?*

Allport (1935) defined an attitude as “*a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual’s response to all objects and situations with which it is related*” (p. 810). The definition describes attitude as a psychological state of readiness towards all objects and situations with which a human interacts. Eagly and Chaiken (1993) defined an attitude as “*... a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour*” (p. 1). This definition pointed out the main function of attitude to be the psychological evaluation. When we have an attitude towards an object, behaviour, or a concept, we can like, dislike or neutrally respect the matter. We evaluate an object in our

mind. The evaluation is based on various criteria such as values and beliefs. The result of the evaluation can be seen as Allport's mental state of readiness and Eagly and Chaiken's psychological tendency i.e. both relate to the central dimension of good-bad.

In summary, an attitude is a psychological response resulting from a mental evaluation towards an object (or situations), which can be located on a positive-negative scale.

#### 2.4.2 *Attitude functions*

Attitude serves many functions, e.g. an object appraisal function or knowledge function, externalisation function or ego-defensive function, and a social adjustment function or self-expressiveness function (Katz, 1960; Smith et al., 1956). First, an object appraisal function was described by Smith et al. (1956) as *"the holding of an attitude provides a ready aid in 'sizing up' objects and events in the environment from the point of view of one's major interests and going concerns"*(p. 41). The knowledge function was considered as *"providing standards or frames of reference for understanding the world"* by Katz (1960, p. 175). Fazio (2000) stated that the object appraisal function could be considered as a main assessment of processing an attitude and the knowledge function may apply attitudes as references for other attitudes. In addition, the knowledge function may facilitate the decision making process (Blascovich et al., 1993; Fazio, Blascovich & Driscoll, 1992). Secondly, Katz (1960) suggested that attitude had an ego-defensive function, which was related to the preservation or endorsement of self-esteem. Smith et al. (1956) referred to the ego-defensive function as an externalisation function. One's attitude towards an 'outgroup' (e.g. racial group) is a good example, which may consider to protect the ego from the 'outgroup' risk (Herek, 1987). Thirdly, the social adjustment function was proposed by Smith et al. (1956) and holds that attitudes support the preservation of relationships with favourable people. Katz (1960) proposed an alternative term - the self-expression function that expressed an individual's values and reinforced the individual's desired sense. Furthermore, attitude functions are

associated with attitude objects and the attitude objects can trigger the related functions (Kruglanski & Stroebe, 2005).

#### 2.4.3 *Social norms, their relationship with attitude, and social desirability*

Social norms are widely used concepts. Cialdini and Trost (1998, p. 152) defined social norms as “*rules and standards that guide and/or constrain social behaviour without the force of the laws ... come from social networks, not the legal systems.*” Hence, social norms were seen as rules and standards influencing the individual’s behaviour in a social context. They also pointed out that the sources of social norms were social networks. Likewise, Prislin and Wood (2005, p667) suggested the definition that social norms are “*shared belief systems about what people typically do or what they ideally should do.*” The definition mentioned that social norms involve shared beliefs and how the beliefs act as a sort of guideline for an individual’s behaviours. For example, in a situation when everyone is waiting in a queue, it is very impolite if a person skips the queue to get in first; because the person is expected to wait in the queue like the others. In the example, the social norms related to behaviour in a queue involve waiting in your own position and not invading someone else’s position.

Social norms can be divided into two types: descriptive and injunctive social norms. In psychology, a descriptive social norm refers to an individual’s perception of what is socially common. That is, what a majority of a group does or thinks (or does not do or think), usually in a certain situation. For instance, in Norway, the majority of Norwegians will wait in their own position in a queue and will not skip the queue. On the other hand, an injunctive social norm is about an individual’s perception of social approval. That is related to what an individual should do or should not do in a specified situation. Continuing with the queue example, a Norwegian comes in at the end of a queue and the person should wait in the queue instead of skipping the queue. Prislin and Wood (2005, p 667) pointed out descriptive norms could affect attitudes by presenting social facts of the effective behaviour in the social

context, in contrast, injunctive norms could affect attitudes by specifying a development of self-image, the gain of social rewards and the prevention of punishments. *“All attitudes are social in the sense that they develop, function, and change in reciprocal relation with the social context.”*(Prislin & Wood, 2005, p. 697) Thus, the relationship between attitude and social norm is not so obvious and simple. Social norms provide a framework input to structure, process and modify the evaluation toward an attitude object.

Social desirability represents that one desires to project a positive self image to others, even by dishonesty (Krosnick, Judd & Wittenbrink, 2005). In some social situations, an individual will try to create a positive self image by saying what he or she believes that others expect him or her to do or think instead of what that individual would like to do actually or thinks actually. The phenomenon could create a bias regarding an individual’s response in research and could lead to various measurement errors (Krosnick, Judd & Wittenbrink, 2005). People generally have a motive to maintain their self image in a social context (Sedikides & Strube, 1997). Hence, social desirability should be taken into consideration when it comes to concluding something concerning the relationship between social norms and attitudes.

#### *2.4.4 Personal norms and their relationship with attitude*

In contrast to social norms, personal norms focus on self-expectations (e.g. an individual’s own rules and standards) that guide and/or restrain the individual’s behaviours (Schwartz, 1977). Perugini and his colleagues (2003) reviewed Schwartz’s definition of a personal norm as *“a self-based standard based on one’s internalized values, or expectation for behaviour, which is enforced through the anticipation of self-punishments and self-rewards”* (p. 253). Additionally, Bamberg, Hunecke and BlöBaum (2007) clarified that personal norms were based on attempts to avoid negative self-related feelings (e.g. guilt and regret) and because these feelings were expected from incompliance with personal norms.

Based on the definitions of attitude and personal norms, the concepts have a certain degree of similarity. However, Schwartz and Howard (1984) clarified the differences between the two: *“Whereas other attitudinal concepts refer to evaluations based on material, social, and/or psychological payoffs, personal norms focus exclusively on the evaluation of acts in terms of their moral worth to the self”*(p. 245). Furthermore, the relationship between attitude and personal norms was frequently addressed on which is a better predictor of a behaviour (e.g. Nigbur, Lyons & Uzzell 2010; Thøgersen 2002).

#### 2.4.5 Knowledge, experience (of certain actions), and their relationships with attitude

Knowledge is a difficult concept to be defined. Colman (2003) defined knowledge as *“Anything that is known”* (p. 394) and described the definition further that knowledge includes *“knowing that,” “knowing how,”* and *“knowing people, places and things”* (p. 394). This definition was applied to construct the general environmental knowledge variables in the pilot study. Knowledge can be one of the criteria that attitude applies to in the mental evaluation. Arcury’s research (1990) pointed out that there was a correlation between knowledge and attitude. Arcury (1990) suggested that the relation between knowledge and attitude occurred when they focused on a common target. In addition, Bradley, Waliczek and Zajicek (1999) also found out that knowledge correlated positively with attitude. In their research, the sample with the higher environmental knowledge score had more favourable environmental attitude. More research also supported that knowledge has a correlation with attitude (Vodopivec et al., 2002; Kruse & Card, 2004). However, even if there is a correlation between knowledge and attitude, knowledge may not have an impact on attitude change (Brossard, Lewenstein & Bonney, 2005).

The term ‘experience’ has often been applied in psychology. However, there was not a straightforward definition of experience. Bradley (2005) described an experience that *“is what psychologists study. Their investigations cover everything from parameters of pattern*

*recognition and how rats learn from electric shocks to the cognitive basis for visual illusions and why new mothers get depressed” (p. 1).* Middleton and Brown (2005) described experience as a dynamic memory of an individual’s living existence in the past and present. These definitions seem to see experience as anything that an individual has or had contact with. Thus, experience should have a relationship to attitude. Previous research associated the relationship between experience and attitude with the frequency of experience and attitude strength (Bassili, 1996; Haddock et al 1996). Furthermore, Millar and Millar (1996) stated that direct experience led attitude to be rather affective and indirect experience led attitude to be rather cognitive.

#### 2.4.6 *Attitude change and habit*

Attitude change is desired when an individual desires to change the attitude-relevant behaviour. However, the process of attitude change can be very complex. The process can occur on an individual level and/or a social level. At an individual level, motivation can be an important trigger to attitude change, and it would involve knowledge, consistency, self-worth and social approval (Brinol & Petty, 2005). At a social level, social influence can be an essential activator to attitude change, which engages social consensus, majority-minority influence and culture (Prislin & Wood, 2005). However, the context of an attitude may influence the weight of each attitude change trigger. The focus of changing an attitude may also require the heaviest weight of attitude change triggers. Furthermore, communication can also be an effective element in processing attitude change (Johnson, Maio & Smith-McLallen 2005). Communication is a bridge connecting the attitude change target to the sources of attitude change triggers and vice versa. Johnson et al (2005) clarified that communication can influence the effectiveness of attitude change.

Habit was defined (Verplanken & Aarts, 1999) as *“learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or*

*end states*” (p. 104). Habit can create a bypass of the attitude-behaviour relationship (Ouellette & Wood, 1998; Verplanken & Aarts 1999). Veplanken (2006) mentioned habit as a mental construct that comprised the features of lack of awareness, difficulty of control and mental efficiency. Those features might be barriers to implementation of attitude change, and they embrace the consistency of attitude and behaviour.



## 3 Case study

### 3.1 Introduction and aim

Taking away food leftovers in restaurants does not often occur in Norway compared to in China or in the USA, although it is relatively more expensive to dine out in Norway than in China or the USA. Taking away food leftovers therefore does not seem to be encouraged by the economic factor. So, what can influence the attitude to taking away food leftovers in restaurants? The main objective of the case study was to investigate what factors were the most effective in explaining the specific attitude to taking away food leftovers in restaurants. An additional objective was to investigate if the explanatory factors differed due to type of restaurant, i.e. not-so-expensive and expensive restaurants. The issue was investigated through a pilot study based on a self-administered survey questionnaire. The following assumptions were of special interest to investigate in the study:

1. General attitude towards food waste is mainly explained by social norms, personal norms, frequency of experiences, and environmental knowledge.
2. General attitude towards food waste has strong relations with attitudes to taking away food leftovers in restaurants.
3. The attitude to taking away food leftovers in not so expensive restaurants can be explained by contributions related to social norms, personal norms, frequency of experiences, and environmental knowledge.
4. The attitude to taking away food leftovers in expensive restaurants can also be explained by contributions from social norms, personal norms, frequency of experiences, and environmental knowledge.
5. General attitude is expected to correlate positively with specific attitudes.

6. There is no difference in the attitude to taking away food leftovers between males and females.
7. There is a difference in the attitude to taking away food leftovers between Norwegian and non Norwegian students.
8. Environmental knowledge correlates with general attitude.

### **3.2 Study design**

The study was conducted by a self-administered questionnaire survey (see appendix ). Thus, the case study used a correlational design, and the questionnaire was administered once. The questionnaire included the following areas: background information of the respondents, restaurant types, the frequency of visiting restaurants, the number of people visiting restaurants together, attitudes, personal norms, social norms, personal experiences, and knowledge about selected environmental issues. Background information included only age, gender, regional area where the respondent had lived the longest time, and type of chosen education faculty, which rendered the participants anonymous. The restaurant types served as a categorising variable.

The attitudes were used as dependent variables. Due to the sample size, the three dependent variables were examined separately. The general attitude index was also included in the regression analyses for specific attitudes for theoretical reasons, but did not emerge as a predictor. The first dependent variable was the attitude to food wasting. The other two dependent variables focused respectively on the attitude to the behaviour of taking away food leftover from ordered food in 1) a not so expensive restaurant and 2) an expensive restaurant. Personal norms, social norms, personal experiences, and knowledge about environmental issues served as independent variables to investigate their contribution in explaining variance in the dependent variables.

### 3.3 Sample and Procedure

Students at the Norwegian University of Science and Technology were the respondents in the study. The survey was completed voluntarily by the students and they were informed about their rights according to the standard ethical rules. The questionnaires were handed out in the different cafes and canteens in the Dragvoll campus and the Gløshaugen campus. All participants were given a brief oral introduction about the questionnaire survey. This information was also written on the first page of the questionnaire.

Three hundred questionnaires were distributed and 184 questionnaires were returned. The response rate was 61.33%. Table 1 displays a cross-tabulation of the sample resulting from regional, age and gender groups. The female group has 126 participants (108 Norwegians and 18 from outside Norway) and the male group has 58 participants (39 Norwegians and 19 non Norwegians) in total. One hundred and forty seven participants were Norwegian and 37 were from outside Norway. The table also presents five age groups and shows that the majority of respondents were between 20 and 25 years of age.

Table 1  
*Region, age and gender Cross-tabulation*

			Age					Total
			Below 20	20-22	23-25	26-29	30 or older	
Female	Region	Norway	11	39	42	14	2	108
		Outside Norway	0	5	6	1	6	18
	Total		11	44	48	15	8	126
Male	Region	Norway	3	15	11	9	1	39
		Outside Norway	0	3	9	5	2	19
	Total		3	18	20	14	3	58
Total	Region	Norway	14	54	53	23	3	147
		Outside Norway	0	8	15	6	8	37
	Total		14	62	68	29	11	184

### 3.4 Questionnaire

The aim of the questionnaire survey applied in the current study was to investigate attitudes towards food leftover in restaurants. For that reason, the survey also measured personal norms, social norms, personal experiences related to food leftovers, and knowledge about environmental issues. There were in total 134 items in the questionnaire. Composite constructs, i.e. indices, were applied to explore the relations between the attitude measures and other concepts. In the questionnaire, each section from D to H is organised to measure a target concept: D is about attitude; E is about personal norms; F is about social norms; G is about personal experience and H is about environmental knowledge (see appendix ).

Moreover, in section B, the presentation of types of restaurants (not so expensive or expensive) served as categorising factors of different types of restaurants (in the section from D to F). In section D to F, the respondents were asked to evaluate their opinions of the provided statements using a Likert scale (i.e. 1 = “Strongly disagree”, 2 = “Disagree”, 3 = “Neither/nor”, 4 = “Agree”, and 5 = “Strongly agree”). Section D was divided into two parts. The first part (D1) measured the attitude towards food wasting, and the second part (D2) measured the attitude towards food leftovers in two types of restaurants (i.e. “Not so expensive” and “Expensive”). Section E contained the statements related to personal norms towards food waste and Section F focused on social norms related to food waste, and involved variables measured with descriptive and injunctive social norms. In Section G, the respondents were required to respond regarding how often they had certain experiences. The response scale in this section had two types of formats: 1) 1 = “Never”, 2 = “1-2 times”, 3 = “3-4 times”, 4 = “5-6 times” and 5 = “over 6 times”; 2) 1 = “Never”, 2 = “Rarely”, 3 = “Sometimes”, 4 = “Often” and 5 = “ Very often”. Section H contained knowledge statements and the respondents were asked to select a response (i.e. true or false) to each statement.

### 3.5 Construction of indices

Thirteen indices were constructed from the initial variables of the sections D, E, F, G and H in the questionnaire. Principle component analyses were applied to examine the structure of the variables in the sections D1, E, F and G. The analyses aimed at sorting the variables into indices. The correlated variables were used to calculate the internal consistency of each index, using Cronbach's alpha. The following 13 indices were constructed, see table 2:

Table 2

*Number of items involved and Cronbach's alpha of each index.*

Name of Index	No. of items	$\alpha$ value
1. Attitude to taking food leftovers in not so expensive restaurants	8	.87
2. Attitude to taking food leftovers in expensive restaurants	8	.85
3. General attitude towards wasting food	4	.71
4. Personal norm of taking away food leftovers	3	.82
5. Personal norm of caring about food waste	3	.60
6. Social norm of taking away food leftovers	9	.72
7. Social norm of the acceptance of taking away food leftovers	1	N/A
8. Social norm of caring not to waste food	5	.67
9. Social norm of table manners	2	.69
10. Frequency of experiences of taking away food leftovers in the life time	3	.80
11. Frequency of experiences of parents teaching not to waste food	1	N/A
12. Frequency of experience of taking away food leftovers in the last 12 months	4	.73
13. Score of general environmental knowledge	18	N/A

The indices 1, 2 and 3 were used as dependent variables in different analyses and the indices or single items from 4 to 13 were used as the independent variables.

### **3.6 Statistical analyses**

In the process of constructing indices, principle component analysis and internal reliability analysis were employed to select items and to test the reliability of the indices. The Cronbach's alpha value from reliability analysis determined the internal consistence of the indices. The criteria is suggested to follow the rules of thumb “ $\alpha > .9$ : excellent;  $\alpha > .8$ : good;  $\alpha > .7$ : acceptable;  $\alpha > .6$ : questionable;  $\alpha > .5$ : poor, and  $\alpha < .5$ : unacceptable” (George & Mallery, 2003, p. 231). The missing data were treated with pair-wise deletion. Moreover, the independent-sample t-test analysed differences of responses from female and male groups, and between those groups native to Norway and from outside Norway. Number of respondents, mean values, and standard deviations were provided by the descriptive statistics of the variables, and were categorised in the female-male and Norway-outside Norway groups. Lastly, the Pearson's correlation analysis measured the strength of the relations between the included variables. Pearson's correlation coefficients were generated by the Pearson's correlation analysis to measure the strength of the relationships between variables. The Pearson's coefficient indicates the effect size (Field, 2009, p. 192). Cohen (1988) pointed out that the correlations are considered as having a small effect between 0.10 and 0.29, a medium effect between 0.30 and 0.49, and a large effect between 0.50 and 1.00. In addition, stepwise linear regression analyses were applied to investigate the predictors of general attitude towards food waste and specific attitudes to taking away food leftovers in restaurants.

### **3.7 Results**

Firstly, this section demonstrates descriptive statistics of the variables presented in table 2 based on gender groups and regional groups. Secondly, the Pearson's correlation coefficients of the same variables are presented and they exhibit the strength of the

relationships between these variables. Finally, the results of the stepwise regression analyses predicting the various attitudes are presented.

### *3.7.1 Descriptive statistics*

Table 3 displays the descriptive statistics and independent t-tests (two-tailed) of male and female groups. In comparing female and male groups, the t-test results showed that there was no significant difference regarding the attitudes to taking away food leftovers, i.e. neither in not so expensive restaurants nor in expensive restaurants. In addition, there was no significant difference in the general attitude towards wasting food in the index between female and male groups.

The overall sample had a positive general attitude toward food waste ( $M = 4.03$ ), which meant that the sample considered it positive not to waste food in general. Attitudes to taking away food leftovers in restaurants were also on the positive side of the scale (not so expensive restaurants:  $M = 3.73$ ; expensive restaurants:  $M = 3.60$ ). The results indicate that the sample would be inclined to take away food leftovers in restaurants and would not consider the behaviour as negative. Furthermore, the personal norm of taking away food leftovers (mean=3.05) and the social norm of taking away food leftovers (mean=3.08) were nearly at the mid-point of the scale. Thus, the overall sample might not consider much the actual behaviour of taking away food leftovers. Contrary to that, the personal norm of caring about food waste (mean= 4.17), the social norm of the acceptability of taking away food leftovers (mean =3.82), and the social norm of caring not to waste food (mean = 3.83) showed higher mean values on the positive side of the scale. The sample seemed to have positive mental concepts of handling food leftovers and waste, although the personal as well as social norms related to the actual behaviour of taking away food leftovers was not emphasised.

Table 3

*Descriptive statistics of indices and independent-sample t-test comparing female and male groups*

Indices and items	Female			Male			Total			t-test	
	M	SD	N	M	SD	N	M	SD	N	t <sub>(df)</sub>	P
1. Attitude to taking away food leftovers in not so expensive restaurants <sup>1</sup>	3.69	.71	124	3.83	.64	58	3.73	.69	182	- 1.28 <sub>(1,180)</sub>	.20
2. Attitude to taking away food leftovers in expensive restaurants <sup>1</sup>	3.56	.72	124	3.69	.69	58	3.60	.71	182	- 1.20 <sub>(1,180)</sub>	.23
3. General attitude towards food waste <sup>1</sup>	4.06	.53	125	3.95	.69	58	4.03	.58	183	1.23 <sub>(1,181)</sub>	.22
4. Personal norm of taking away food leftovers <sup>1</sup>	3.07	.83	122	3.01	.93	58	3.05	.86	180	.40 <sub>(1,178)</sub>	.69
5. Personal norm of caring about food waste <sup>1</sup>	4.17	.52	122	4.16	.54	58	4.17	.53	180	.17 <sub>(1,178)</sub>	.87
6. Social norm of taking away food leftovers <sup>1</sup>	3.07	.56	120	3.12	.56	57	3.08	.56	177	-.61 <sub>(1,175)</sub>	.55
7. Social norm of the acceptability of taking away food leftovers <sup>1</sup>	2.17	.86	119	2.21	.87	56	3.82	.86	175	-.33 <sub>(1,173)</sub>	.74
8. Social norm of caring not to waste food <sup>1</sup>	3.83	.54	120	3.83	.64	57	3.83	.57	177	.05 <sub>(1,175)</sub>	.96
9. Social norm of table manners <sup>1</sup>	3.08	.83	120	2.96	1.07	57	3.04	.91	177	.84 <sub>(1,175)</sub>	.40
10. Frequency of experience of taking away food leftovers in the life time <sup>2</sup>	2.64	1.32	120	2.68	1.35	55	2.66	1.32	175	-.19 <sub>(1,173)</sub>	.85
11. Frequency of experience of parents teaching not to waste food <sup>2</sup>	4.41	1.15	117	4.25	1.29	55	4.36	1.19	172	.70 <sub>(1,170)</sub>	.43
12. Frequency of experience of taking away food leftovers in the last 12 months <sup>3</sup>	1.84	.91	120	1.87	.84	55	1.85	.88	175	-.17 <sub>(1,173)</sub>	.86
13. Score of general environmental knowledge <sup>4</sup>	11.2 8	2.25	120	11.4 2	2.66	55	11.3 2	2.38	175	-.37 <sub>(1,173)</sub>	.71

Note:

1. Scale: 1. "Strongly negative", 2. "Negative", 3. "Neither nor", 4 "Positive" and 5 "Strongly positive";

2. Scale: 1. "Never", 2. "1-2 times", 3 "3-4 times", 4 "4-5 times" 5. "6 times or more".

3. Scale: 1. "Never", 2. "rarely", 3 "sometimes", 4 "often", 5 "very often".

4. Scale: 1-18, the sum index is based on 18 items and a correct response gives one score.

In Table 4, the data show that the students from Norway differed significantly regarding general attitude toward food waste as compared to the students from outside Norway ( $t = -2.58$ ,  $df = 1, 181$ ,  $p < 0.05$ ).

Table 4

*Descriptive statistics of indices and independent-sample t test between groups from Norway and from outside Norway. (The total sample results for provided in Table 1)*

Indices and Items	Norway			Outside Norway			t-test t(df)
	M	SD	N	M	SD	N	
1. Attitude to taking away food leftovers in not so expensive restaurants	3.72	.64	145	3.79	.86	37	-.51 <sub>(1,180)</sub>
2. Attitude to taking away food leftovers in expensive restaurants	3.56	.67	145	3.77	.87	37	-1.61 <sub>(1,180)</sub>
3. General attitude towards food waste	3.97	.58	146	4.24	.56	37	-2.58 <sub>(1,181)</sub> *
4. Personal norm of taking away food leftovers	2.97	.84	144	3.40	.85	36	-2.76 <sub>(1,178)</sub> **
5. Personal norm of caring about food waste	4.13	.54	144	4.31	.46	36	-1.77 <sub>(1,178)</sub>
6. Social norm of taking away food leftovers	3.01	.52	140	3.36	.60	37	-3.49 <sub>(1,175)</sub> **
7. Social norm of the acceptability of taking away food leftovers	2.06	.78	140	2.69	.96	35	- 4.04 <sub>(1,173)</sub> ***
8. Social norm of caring not to waste food	3.77	.55	140	4.06	.61	37	-2.82 <sub>(1,175)</sub> **
9. Social norm of table manners	2.99	.94	140	3.24	.78	37	-1.53 <sub>(1,175)</sub>
10. Frequency of experience of taking away food leftovers in the life time	2.66	1.32	138	2.66	1.35	37	-.01 <sub>(1,173)</sub>
11. Frequency of experience of parents teaching not to waste food	4.36	1.19	137	4.34	1.21	35	.10 <sub>(1,170)</sub>
12. Frequency of experience of taking away food leftovers in the last 12 months	1.75	.84	138	2.23	.96	37	-3.05 <sub>(1,173)</sub> **
13. Score of general environmental knowledge	11.73	1.88	138	9.78	3.30	37	4.68 <sub>(1,173)</sub> ***

\*= significant at  $p < 0.05$ ;

\*\*= significant at  $p < 0.01$

\*\*\*= significant at  $p < 0.001$

Note: Total sample of Mean, SD and Number is in table 1

The participants from outside Norway ( $m = 4.24$ ) had a more positive general attitude towards handling food waste than the participants from Norway ( $m = 3.97$ ). This shows that the participants from outside Norway considered the handling of food waste more positively compared to the participants from Norway. However, there were no differences between the

two groups on attitudes towards taking away food leftovers in the two types of restaurants. It is interesting to note the larger difference between mean values in the restaurant related attitudes in the Norwegian group and the relatively smaller difference in this group between restaurant related attitudes and general attitude as compared to the non-Norwegian group.

Furthermore, the personal norm of taking away food leftovers differed significantly between the group from outside Norway and the group from Norway. The participants from outside Norway felt more positively as individuals towards taking away food leftovers ( $m=3.40$ ) compared to the participants from Norway ( $m=2.97$ ). However, due to the uneven group size, all results must be interpreted with caution. The social norm of taking away food leftovers also differed significantly between the groups from Norway and from outside Norway. The participants from outside Norway perceived the social norm more positively with regard to taking away food leftovers ( $m = 3.36$ ) than the participants from Norway ( $m=3.01$ ). Similarly, the social norm of the acceptability of taking away food leftovers was perceived as more positive by the participants from outside Norway ( $m = 2.69$ ) than by the participants from Norway ( $m=2.06$ ). The difference between the two groups of participants was highly significant ( $p<.001$ ). Note, however that “the social norm of acceptability” was considerably lower in both groups as compared to the “social norm” index. Moreover, the social norm of caring not to waste food also shows a significant difference between the two groups, and the participants from outside Norway ( $m=4.06$ ) rated this norm higher in a positive dissection than the participants from Norway ( $m=3.77$ ). Regarding the frequency of experience of taking away food leftovers in the last 12 months, the sample from outside Norway ( $m=2.23$ ) between “rarely” and “sometimes” according to the scale had more frequent experience than the sample from Norway ( $m = 1.75$ ) closer to “rarely” than “never” on the response scale, a result significant at the 0.001 level.

Lastly, the item of ‘frequency of experience of parents teaching not to waste food’ was not normally distributed. It was removed from the correlation analysis and regression analyses. The results are presented in the Table 5. It can be seen in the table, the majority of students had heard their parents repeat the statement of not wasting food over six times.

Table 5  
*Frequency of experience of parents teaching not to waste food*

		Frequency	Percent	Valid Percent
Valid	Never	8	4.3	4.7
	1-2 times	13	7.1	7.6
	3-4 times	15	8.2	8.7
	5-6 times	9	4.9	5.2
	Over 6 times	127	69.0	73.8
	Total	172	93.5	100.0
Missing	System	12	6.5	
Total		184	100.0	

3.7.2 *Interrelationships*

Table 6 below presents the correlations between all central variables. General attitude showed medium strength relations with attitudes to take away food leftovers in restaurants (not so expensive restaurants:  $r = .33, p < .01$ ; expensive restaurants:  $r = .31, p < .01$ ). As a result, the general attitude toward food waste had approximately ten per cent overlap of variance with the attitudes to taking away food leftovers in restaurants.

The index of personal norms shows rather a strong relationship between attitudes to taking away in restaurants (not so expensive:  $r = .37, p < 0.01$ , expensive:  $r = .35, p < .01$ ) and with the general attitude toward food waste ( $r = .52, p < .01$ ). The personal norm of taking away leftovers had a stronger relationship with general attitude than with the specific attitudes to taking away food leftovers in restaurants. Moreover, the index of personal norms of caring about food waste correlated weakly with attitudes to taking away food leftovers in restaurants

(not so expensive:  $r = .19, p < .01$ , expensive:  $r = .24, p < .01$ ). On the other hand, the personal norm of caring about food waste had a stronger correlation with the general attitude toward food waste ( $r = .49, p < .01$ ). Thus, the results indicate that the personal norm of caring about food waste has a stronger relationship with the general attitude than with specific attitudes related to behaviour in restaurants.

Table 6

*Interrelationships between central variables, and Pearson's correlations coefficients*

Indices and Item	1	2	3	4	5	6	7	8	9	10	11	12
1. Attitude to taking away food leftovers in not so expensive restaurants (n=182)	1.00											
2. Attitude to taking away food leftovers in expensive restaurants (n=182)	.85**	1.00										
3. General attitude towards food waste (n=182-183)	.33**	.31**	1.00									
4. Personal norm of taking away food leftovers (n=180)	.37**	.35**	.52**	1.00								
5. Personal norm of caring about food waste (n=180)	.19**	.24**	.49**	.31**	1.00							
6. Social norm of taking away food leftovers (n=177-176)	.27**	.30**	.27**	.40**	.05	1.00						
7. Social norm of the acceptability of taking away food leftovers (n=175-174)	.06	.08	.02	.13	.19*	.13	1.00					
8. Social norm of caring not to waste food (n=177-175)	.36**	.37**	.64**	.51**	.54**	.32**	-.05	1.00				
9. Social norm of table manners (n=177-175)	.06	-.04	.14	.30**	.12	.03	.10	.17*	1.00			
10. Frequency of experience of taking away food leftovers in the life time (n=175-174)	.31**	.29**	.18*	.29**	.14	.60**	-.12	.22**	.03	1.00		
11. Frequency of experience of taking away food leftovers in the last 12 months (n=175-173)	.17*	.16*	.24**	.27**	.14	.31**	.00	.20**	.20**	.25**	1.00	
12. Score of general environmental knowledge (n=175-173)	-.03	-.05	-.10	-.05	.00	.00	.26**	-.05	-.08	.12	.17*	1.00

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

Note: in a column, upper cell: the Pearson's correlation coefficients; lower cell: number of participants.

Regarding the social norm measures, only the social norm of taking away food leftovers and the social norm of caring not to waste food, had correlations with the attitude variables. Firstly, the social norm of taking away food leftovers had a rather small effect size (not so expensive restaurants:  $r = .27, p < .01$ ; expensive restaurants:  $r = .30, p < .01$ ; general attitude:  $r = .27, p < .01$ ). Additionally, the social norm of taking away food leftovers had an intermediately strong relationship with the personal norm of taking away food leftovers ( $r = .40, p < .01$ ). Secondly, the social norm of caring not to waste food had a stronger correlation with the general attitude index than the indices of attitudes to take away food leftovers in restaurants (not so expensive:  $r = .36, p < .01$ ; expensive:  $r = .37, p < .01$ ; general attitude:  $r = .64, p < .01$ ). Plus, this social norm had a strong relationship with the personal norm of taking away food leftovers ( $r = .51, p < .01$ ) and the personal norm of caring about food waste ( $r = .54, p < .01$ ). The social norm of the acceptability of taking away food leftovers correlated negatively with the personal norm of caring about food waste ( $r = -.19, p < .05$ ). Hence, an individual who cares more about food waste, also perceived less social acceptability in the taking away of food leftovers.

Note however, that the social acceptability measure is based on a single item. The index of frequency of experience of taking away food leftovers in the lifetime had a low but significant relationship with all attitude indices. The relationships included a small effect size relative the general attitude index ( $r = .18, p < .05$ ) and somewhat higher ones regarding the index of attitude in expensive restaurants ( $r = .29, p < .01$ ), and the index of attitude in not so expensive restaurants ( $r = .31, p < .01$ ). In addition, the frequency of experience of taking away food leftovers in the life time correlated strongly and positively with the social norm of taking away food leftovers ( $r = .60, p < .01$ ). Hence, a person would have a stronger social norm of taking away food leftovers, if the person had also had more frequent previous experiences of taking away food leftovers.

Finally, general environmental knowledge as measured in this study did not correlate significantly with the attitudes to behaviours in restaurants or the general attitude. However, it did have a negative, significant, correlation with the social norm of the acceptability of taking away food leftovers ( $r = -.26, p < .01$ ). The common variance is .07 (7%) and the relationship would need further investigation before further evaluation.

### *3.7.3 Regression analyses of attitudes to taking away food leftovers in restaurants*

Firstly, the regression result related to general attitude toward food waste is presented in the table 7 (Adj.  $R^2 = .48, F = 52.59, df = 3, 166, p < .001$ ). In this model, the final step involved three predictors, with a strong impact of the social norm of caring not to waste food. In addition, the personal norm of taking away food leftovers, and the personal norm of caring about food waste. The social norm had the highest weight as a predictor in the model, indicating a strong influence of the social norm on the general attitude.

Secondly, table 8 presents the regression results from a stepwise procedure to determine the predictors of attitude to taking away food leftovers in not so expensive restaurants. In the third step, the personal norm of taking away food leftovers, frequency of experience of taking away food leftovers in the lifetime, and the social norm of caring not to waste food entered the equation. Together they contributed somewhat to explain the variance regarding the attitude to taking away food leftovers in not so expensive restaurants (Adj.  $R^2 = .20, F = 14.79, df = 3, 166, p < .001$ ). The predictors of personal norm, experience and social norm contributed approximately equally. ( $\beta = .21$ ).

Table 7

*General attitude toward food waste*

Model		B	SE	Beta	R <sup>2</sup>	Adj. R <sup>2</sup>	F	df
1	(Constant)	1.52	.23		0.41	0.41	118.13*	1, 168
	Social norm of caring not to waste food	.65	.06	.64				
2	(Constant)	1.50	.22		0.46	0.46	71.62*	2, 167
	Social norm of caring not to waste food	.52	.07	.51				
	Personal norm of taking away food leftovers	.17	.04	.26				
3	(Constant)	1.02	.27		0.49	0.48	52.59*	3, 166
	Social norm of caring not to waste food	.42	.07	.41				
	Personal norm of taking away food leftovers	.17	.04	.25				
	Personal norm of caring about food waste	.21	.07	.19				

\* = significant level  $p < 0.001$ 

Table 8

*Attitude to taking away food leftovers in not so expensive restaurants*

Model		B	SE	Beta	R	Adj. R <sup>2</sup>	F	df
1	(Constant)	2.84	.18		.13	.13	26.04*	1, 169
	Personal norm of taking away food leftovers	.29	.06	.37				
2	(Constant)	2.69	.18		.18	.17	18.09*	2, 168
	Personal norm of taking away food leftovers	.24	.06	.30				
	Frequency of experience of taking away food leftovers in the life time	.11	.04	.22				
3	(Constant)	2.00	.32		.21	.20	14.79*	3, 167
	Personal norm of taking away food leftovers	.16	.07	.20				
	Frequency of experience of taking away food leftovers in the life time	.11	.04	.20				
	Social norm of caring not to waste food	.25	.10	.21				

\* = significant level  $p < 0.001$

Furthermore, table 9 displays the regression analysis results regarding attitude to taking away food leftovers in expensive restaurants. The predictors in this case of attitude to taking away food leftovers in expensive restaurants included the same three predictors as in the analysis of attitude in not so expensive restaurants, and also an extra predictor that was the social norm of table manners (Adj.  $R^2 = .21$ ,  $F = 12.04$ ,  $df = 4, 166$ ,  $p < .001$ ). Note, however, that the social and personal norms were the dominating predictors in attitude to taking away food leftovers in expensive restaurants, closely followed by personal norms.

Table 9

*Attitudes to taking away food leftovers in expensive restaurants*

Model		B	SE	Beta	$R^2$	Adj. $R^2$	F	df
1	(Constant)	1.83	.34		0.14	0.13	27.03	1, 169
	Social norm of caring not to waste food	.46	.09	.37			*	
2	(Constant)	1.75	.34		0.18	0.17	18.69	2, 168
	Social norm of caring not to waste food	.40	.09	.32			*	
	Frequency of experience of taking away food leftovers in the life time	.12	.04	.22				
3	(Constant)	1.74	.33		0.20	0.19	14.25	3, 167
	Social norm of caring not to waste food	.30	.10	.24			*	
	Frequency of experience of taking away food leftovers in the life time	.10	.04	.18				
	Personal norm of taking away food leftovers	.15	.07	.18				
4	(Constant)	1.98	.35		0.23	0.21	12.04	4, 166
	Social norm of caring not to waste food	.31	.10	.25			*	
	Frequency of experience of taking away food leftovers in the life time	.09	.04	.17				
	Personal norm of taking away food leftovers	.18	.07	.22				
	Social norm of table manners	-.12	.06	-.15				

\* = significant level  $p < 0.001$

The negative sign related to the social norm of table manners shows that those less compliant with social rules of table manners are more expected to take away leftovers. The three regression analyses showed that the general environmental knowledge index did not contribute as a predictor to attitudes at all.

#### *3.7.4 Summary of the results*

There was no statistically significant difference in the attitudes to taking away food leftovers in restaurants between males and females in the study. However, a significant difference in attitudes showed between the Norwegian and non Norwegian groups. General attitude towards food waste had three predictors, which were the social norm of caring not to waste food, the personal norm of taking away food leftovers, and the personal norm of caring about food waste. General attitude toward food waste showed a medium strength correlation (around .30) with the specific attitudes to taking away food leftovers in restaurants.

The predictors of attitude to taking away food leftovers in not so expensive restaurants involved, the personal norm of taking away food leftovers, frequency of experiences of taking away food leftovers, and the social norm of caring not to waste food. Attitude to taking away food leftovers in expensive restaurants had four predictors, three were the same as for attitude in not so expensive restaurants, and the extra predictor was the social norm of table manners. The social norm of caring not to waste food appeared as a major element to predict general attitude and attitude to taking away food leftovers in expensive restaurants in Norway. Regarding the not so expensive restaurant situation, the personal norm and experience had the approximate same impact as the social norm. Environmental knowledge did not have a significant correlation with attitudes in this study.

#### *3.7.5 Discussion of the case study*

The pilot study case presented the influencing factors of the attitudes to taking away food leftovers in restaurants that were based on a sample of NTNU students. Social norms

were the main predictors. The social norm of caring not to waste food was the major predictor in both attitudes to take away food leftovers in the not so expensive restaurants and the expensive restaurants.

Assumption 1: Attitude to taking away food leftovers in not so expensive restaurants can be explained by social norm, personal norm, frequency of experience and general environmental knowledge.

This first assumption was partly supported, although the general environmental knowledge did not contribute to explain the attitude to taking away food leftovers in not so expensive restaurants. The weakest relationship is found between general environmental knowledge and attitude. The Pearson's correlation coefficients between environmental knowledge and attitudes were almost zero. From the participants' point of view, the behaviour of taking away food leftovers may not be associated with environmental issues and concepts. Several studies supported that environmental knowledge has a weak relationship to environmental attitude and the behaviour related to the attitude (Nemcsicsné Zsóka, 2008; Kuhlemeier, Van Den Bergh & Lagerweij, 1999; Lyons & Breakwell, 1994; Al-Najede, 1990). Although the weak influence of environmental knowledge did not seem to contribute to environmental attitude, increasing environmental knowledge could increase the awareness of the related environmental issues and behaviours (Nemcsicsné Zsóka, 2008). Moreover, it could be also the wrong environmental knowledge that was targeted to connect to the attitudes (Ajzen & Fishbein 1980). Refsgaad and Magnussen (2009) pointed out that having the relevant knowledge towards a target environmental problem could have a positive influence on the attitude towards the same problem. The relevant environmental knowledge of the attitude object could affect the attitude towards the attitude object. In this case, emphasising the connection between the issues of food wastes, food leftovers and environmental consequences might be a good idea to strengthen the relationship between environmental

knowledge and relevant attitude. Additionally, the emphasis for the future change should focus on developing a positive loop. For instance, taking away food leftovers is equal to an initiative step of reducing food waste and potentially leads to less greenhouse gas (GHG) emissions, where not taking away food leftovers increases food waste and results in more GHG emissions. Even though a person has high environmental knowledge to the attitude object, the person's attitude toward the subject can be negative (Desa, Kadir & Yusooff, 2011).

Nevertheless, the attitude to taking away food leftovers in not so expensive restaurants was only able to be explained 20 per cent by the social norm of caring not to waste food, the personal norm of taking away food leftovers and frequency of experience of taking away food leftovers in the lifetime. The social norm of caring not to waste food leftovers contributed the explained variance of the attitude, instead of the social norm of taking away food leftovers. However, the 'taking away food leftovers' behaviour seemed to be embraced at the personal norm level rather than at a social level.

Furthermore, the rest of the unexplained variance raised the question of what other factors could influence the attitude. The influencing factors could be, for instance, the portion size of the food leftovers (i.e. 80% left on the plate versus 10% left on the plate), the taste of the food (e.g. delicious versus awful), the type of food leftovers (e.g. meat versus rice etc.) or the availability of take-away food containers.

Assumption 2: Attitude to taking away food leftovers in expensive restaurants can be also explained by social norms, personal norm frequency of experiences and environmental knowledge.

The second assumption had a similar outcome to the first assumption, and all factors except environmental knowledge contributed to predict the attitude. Firstly, the attitude in expensive restaurants correlated highly to the attitude of taking away food leftovers in not so

expensive restaurants. The predictors from the attitude in not so expensive restaurants also contributed to explain the variance in attitude in the expensive restaurants. Hence, there may be many who are surprised that environmental knowledge did not contribute to explaining the attitude to taking away food leftovers in expensive restaurants as well. Secondly, an unexpected influencing factor 'the social norm of table manners' appeared to explain the attitude in expensive restaurants. It contributed as a negative influence. That meant that an individual had a stronger value of the social norm of table manners and also had a weaker attitude to taking away food leftovers in expensive restaurants. In addition, taking away food leftovers could be perceived by the study participants as being bad table manners in expensive restaurants. Thirdly, even though an extra influence factor contributed to explain the attitude in expensive restaurants, the total explained variance only increased by one per cent to 21 per cent. A large amount of unexplained variance was still concealed and it requires further investigation in later research.

Assumption 3: General attitude towards food waste is mainly explained by social norms, personal norms, frequency of experiences and environmental knowledge.

The third assumption had variance in deviations compared to the previous two assumptions. Only norms were able to contribute to explain the general attitude here and they are the social norm of caring not to waste food, the personal norm of taking away food leftovers and the personal norm of caring about food waste. The total explained variance reached 48 per cent. General environmental knowledge seemed to be relevant to the general attitude toward food waste. Food waste like food leftovers may again not be considered as relevant to environmental issues. Environmental knowledge may not connect directly to the domains of food waste or food leftovers. Hence, the correlation coefficient did not show significant strength between environmental knowledge and the general attitude. In addition, the frequency of experience indices (i.e. taking away food leftovers in the lifetime, and in the

last 12 months) did not contribute to explain the general attitude either. The reason could be that the connection between food waste and food leftovers may not be strong yet in peoples' minds.

Moreover, the personal norm was the dominant predictor of explaining the general attitude. It illustrated that the students could perceive consciously on an individual level when they considered food waste issues. This result was slightly different from the attitudes related to the two types of restaurants. People's attitudes seemed to be guided mainly by social norms in the two types of restaurants. It could be because the restaurant setting was seen as a social situation when the participants were asked about their thoughts of the general situation of food waste.

#### *3.7.6 Methodological issues*

The data was collected through a self-administered survey questionnaire with closed statements. Brian (2002, p309) pointed out the self-administered survey questionnaire could reach a large sample with low cost of research funding and within a short period time. However, the obtained data information in the case study was limited because of the closed statements of the variable items. The option for free comment was not set up in the survey questionnaire and this restricted extra information input from participants. In addition, there is uncertainty as to whether the questionnaire is able to reflect reality or not. Do people actually behave as they respond on the questionnaire? It might prove difficult to confirm the answer. Social desirability bias can also have an effect on participants. They might respond to a statement in the questionnaire in the way they feel society expects them to respond to that statement.

Furthermore, the participants of the study were only students from the Norwegian University of Science and Technology, Norway. Only 37 international students participated in the survey compared to 147 Norwegian students. The uneven sample size also occurred

between genders. The capability to represent the general population was restricted.

Nonetheless, the results from the participant group could be an implication for a potential solution to create or reinforce the behaviour of taking away food leftovers in restaurants.

The Likert scale format in the section G1 used actual numbers of frequency to evaluate the experience of taking away food leftovers in the lifetime. It may create confusion or random guessing in response to the statement. For example, when asked “how often you experienced your parent teaching you not to waste food in your lifetime”, it is difficult to remember the exact number.

Additionally, the questionnaire was in English and the majority of the participants were Norwegian. English as the second language of the Norwegian participants might provide a language barrier that could result in the misunderstanding of a statement, phrases or vocabulary. For example, ‘food court’ in the type of restaurant section is very rare in Norway and people may not have heard of this type of restaurant.

## 4 Discussion and Conclusion

We humans have always had problems related to maintaining a sufficient amount of food for survival. Most of us are not involved in producing food. We depend on a rather small number of farmers and fishermen to produce food for the rest of us. As long as we as consumers have money to buy food from the supermarket, we should have food. The technologies for assisting in the production of food seem to create the illusion that “food comes easy”. However, indeed, food never comes easily and we seem to forget that. The increasing world population and changing climate conditions are putting burdens on the food situation.

### 4.1 Food as food

Borgstorm in 1973 (pp. 99-106) imagined that the human food resources in the beginning of the 21st century would be substituted by chemical compounds with precise nutritional design. Nowadays, when we pay attention in a grocery store, we see that Borgstorm’s vision is not far away from the current food situation. Many edible products e.g. pizza, potato chips, nutrition bars and protein powder are not the traditional food resources such as vegetables and meats. Edible products such as pizza, potato chips, processed and semi-processed products cannot maintain our long-term health (Chan, 2008); nevertheless, they are considered as food according to the Codex Alimentarius. People may not feel hungry or undernourished by consuming these edible products, at least in a short-term period. However, when we consider what food is, we should not focus only on the short-term benefits but also the long-term benefits from food. We are what we eat. Relevant knowledge of an object can influence the attitude toward the object (Ajzen & Fishbein 1980). Hence,

understanding food and its relationship with humans is important in leading us to a more sustainable situation towards food as food.

Furthermore, the amount of food on show in a grocery store may give us an impression of food sufficiency. The food is yours as long as you have enough money to buy. This might create an unappreciative attitude towards food. Additionally, grocery stores often use various selling methods such as reduced prices and “3 for 2” prices to promote selling their food products. This can reduce the potential food waste in grocery stores; in fact, it transfers the potential food waste to consumers because consumers may buy more food than they need. One third of the quantity of food that households buy is wasted (Quested & Johnson, 2009). The “3 for 2” price trap may be connected to the one-third figure of food waste. According to Quested and Johnson (2009), most food waste is fruit and vegetables because of their short storage period. However, this fruit and vegetable waste may also be the result of an individual diet focus (e.g. vegetable as a side dish in western recipes and as an ingredient in the eastern recipes).

An American TV series called “Jamie’s Food Revolution” ,led by the celebrity chef Jamie Oliver, displayed what the younger ones (i.e. our future generation) have been fed in school. To some extent, the TV show reveals that elementary school children in the USA seem to lack knowledge of food and the fact that the food they consume might lead them to a shorter life span. The children in the show did not have a problem recognising processed food such as pizzas, chicken nuggets and burgers only experiencing problems with recognition of fresh raw vegetables. Processed food was provided as their school lunch by the school. However, if the school only provides processed food to the children it could form the social norm that “it is good to eat processed food”. Children may not be concerned with the relationship between health and food, and will usually eat whatever an adult provides. Thus it depends on the adults’ guidance to understand the relationship between health concerns and

healthy eating attitudes. Concern for health can positively influence healthy eating attitudes (including healthy food choices) (Sun, 2008).

Additionally, a survey conducted by Hillman and Buckley (2011) indicated a large number of Australian school pupils in the study appeared to lack knowledge of where their food came from. Food is of such importance to human beings yet we seem not to care to know much about it. A joint report from the Office for Standards in Education and Food Standards Agency in the UK (2004) suggested that food and nutrition education should start at a young age in order to create a long-lasting lifestyle that includes a healthy diet. Hence, from the perspective of health concern, we should choose more healthy food and eat less processed food or food substitute products. Food security management should have the obligation to assist food consumers in accessing a sufficient amount of healthy food choices and should increase the availability of healthy food choices. In addition, food education (including nutrition facts, food sources, food waste etc.) could be beneficial to introduce early on to schoolchildren and might help to form a correct attitude toward food that benefits human health.

When an individual has a correct attitude toward food, the attitude can function as a gauge for other attitudes toward food related issues.

## **4.2 Food for the hunger population**

Solving the food problem for the hunger population is a challenge. It connects with different management levels in governments and non-governmental organisations. It also connects with various domains such as land use (FAO 2011a), energy demand (Eide, 2008), and gender equity (FAO 2011b). Solutions also need to have short- and long-term focuses, according to the five Rome principles for sustainable global food security (FAO, 2009). The World Food Programme (2012a) presents a practical solution with six different approaches that include nutrition supply for pregnant women and children under two years, school meals,

food aid, food vouchers, small farmer supports, and education and training. The solution seems to cover both short- and long- term perspectives. Food aid and food vouchers can be seen as a short-term focus and the other approaches can be seen as a long-term focus. Additionally, the solution is in compliance with the third of the Rome principles, which acts directly to deal with the most vulnerable hunger population (i.e. food aid and vouchers) and establishes medium– and long-term programmes to eradicate poverty and hunger (by supporting small farmers and education). The other principles do not seem reflect directly in the solution.

Furthermore, recent research from Walpole and her research team (2012) pointed out that the overweight and obese population in developed countries could influence negatively on global food security. The overweight and obese population could be seen as the hunger population with the overeating diet, because they also had strong desire for food and needed more food to satisfy their bigger stomach. Therefore, logically, when we may need more food to fulfil the overeating hunger population, we may have less food to provide to the hunger population with undernourishment. The five Rome principles on food security may not be able to apply to an overeating hunger population. A different solution could be required to solve the overeating hunger population, such as dietary and exercise self-efficacies (Byrne, Barry & Petry 2012), and attitude towards food (Wardle, et al, 1992).

On an individual level in the developed countries, one of the solutions for the global hunger issue can be creating attitude towards, and the behaviour of, consuming healthy and sustainable food choices (e.g. organic food) (e.g. Honkanen, Verplanken & Olsen, 2006; Vermeir & Verbeke, 2006). Healthy and sustainable food choices and environments can help to reduce the overweight and obese population (Cummins & Macintyre, 2006). A smaller overweight and obesity population can reduce the threat for food security (Walpole et al 2012).

### 4.3 Food for fuel

Using food for non biological needs (e.g. producing biofuel) seems to be unethical, while we have 925 million of the world's population suffering from hunger. Certainly, biofuel has many benefits such as sustainable and greenhouse gas reduction (Hill, et al 2006). However, according to a report conducted by Eide (2008), 50 litres of biofuel required about 200 kg of maize - enough to feed *one person for one year*. These 50 litres of biofuel may last for a few weeks of car driving with a daily driving distance of 30km. In the current free trade world market, individuals with stronger purchasing power will have stronger effect on the balance between 50 litres of biofuel and 200 kg of maize (Eide, 2008, p12). The "Food versus Fuel" battle may have started since we discovered that food could become biofuel. The International Transport Forum (ITF, 2011) estimated that the number of global cars and light trucks would increase from the 850 million now to 2.5 billion by 2050. The amount of food for biofuels to fill up all vehicles' tanks in the world might feed the global hunger population for one year.

Furthermore, the Eide's report (2008) also raised several concerns of converting food into biofuel. These were food prices, land concentration and use, water use, women and environment. Several pieces of research also supported the Eide's concerns (e.g. Pimental et al 2009, Rajagopal et al 2009). Therefore, making biofuel from food can lead to a chain of negative ramifications for food security.

Biofuel can be good for the sustainable development of human society, if it is produced from other biomaterials than food (Tilman et al 2009). Hence, the second or third generation biofuels have feedstock from non food crops, organic waste, or algae that are better for food security. Festel (2008) reported the consumer attitude towards biofuel was not optimistic because of the biofuel prices, the requirement of car-engine modification, loss of power, and other reasons. Conversely, it may be fortunate that the attitude was not optimistic. The attitude

might create a high demand for biofuel that could cause more concerns for food security. Hence, until the mature development of the technology to produce second or third generation biofuels, we should not change the non optimistic attitude toward biofuels.

Without fuels, humans may not travel a long distance in a short period; however, without food, humans cannot survive.

#### **4.4 Food should not be wasted**

The percentage of food waste globally has reached approximately *one third* of the produced food every year, that is about 1.3 billion tonnes (FAO, 2011c). Food leftover waste from not taking away in restaurants was considered as food waste during the consumption stage and was at an individual behaviour level, based on the criteria in a FAO report (2011c). Thus, the solution for treating this type of food waste can require a focus at individual levels. FAO (2011c) suggested a change in consumer attitudes was required to reduce or be able to prevent food waste. The hierarchy diagram of food waste management can be a good guideline to establish goals at each level, such as how to reduce and avoid; how to reuse and recycle; and how to treat and dispose (WRAP, 2007).

In the pilot study of leftover food waste in restaurants, social norms, personal norms and frequency of experience contributed to explain the attitudes towards taking away these leftovers. Hence, influencing social norms, personal norms and frequency of experience may assist in changing attitudes towards food waste. Nevertheless, other factors can also contribute to a change in attitude, such as belief (Yakob et al, 2012), education and political initiatives (FAO, 2011c), and awareness (WRAP, 2007; Hansmann et al, 2005). Attitude change can assist in establishing behaviours that will prevent food waste.

Moreover, one may argue that food will not be wasted because nature will decompose it to nourish the eco-system. This argument may be true. However, the food in our modern society requires more effort to manage than ever before through factors other than human

consumption, such as the distance of distribution (Weber & Matthews, 2008) and the use of food production energy (Carlsson-Kanyama, Ekström, Shanahan, 2003). These efforts may have negative impacts on our environment and our nature.

Based on ethical reasons and the efficiency of the current food system, wasting food is an essential area to manage in order to have a sustainable food system.

#### **4.5 Food in politics**

Nestle (2002) in his book asserted that our food has been politicised by the food industry. Lien and Nerlich (2004) mentioned that the politics of food involved many sectors, for instance, trading markets, gendered and unequal distribution, human rights and others. Food in politics has focused on food accessibility and the idea that “food is food” has become complex (Lien & Nerlich, 2004). Food policies are one of the representative domains in food politics and shape what we can consume and eat. The food debate on genetically modified organisms is a good example of how food policies in different countries are managed based on what we can consume.

A sustainable food system should be localised instead of globalised (Hinrichs 2003). Food in politics could also focus on localisation instead of globalisation, for example, supporting local small farmers, developing technology to localize food products from other areas in the world, supporting retailers to sell local food, and educating consumers. On one hand, globalised food may provide a huge trading market, low cost and large variety to the global consumer, but it also may have a negative impact our environment (Watkiss et al2005). On the other hand, localised food can increase food prices, limit the trading market and decrease food choices; however, it can support local community development and have a less negative environmental impact (Marsden, Murdoch & Morgan, 1999).

#### **4.6 Sustainability can ensure food safety**

An early piece of research conducted by Clancy (1986) clarified that sustainable agriculture could improve food safety and quality. Imagine two bowls of strawberries on your kitchen table, one comes from an industrialised farm and they are grown in an environment with farming chemicals (e.g. pesticide and fertilizers), the other comes from a local farm and they are matured in an environment supplied by only natural sources (e.g. insect's natural enemy and fertilizers from biodegradation). We can easily guess which strawberry might be less likely to cause food poisoning to humans.

Industrial farming (e.g. producing the strawberry with pesticide) can have negative health impacts on human health (Bertolote et al, 2006; Horrigan, Lawrence & Walker, 2002). Horrigan and his colleagues' research (2002) indicated that industrial food systems have a negative effect on food safety, such as creating new strains of foodborne pathogens, and residue of antibiotics in animal agriculture. However, sustainable farming may see food safety in a mid-long-term perspective. Asami and his colleagues (2003) provided evidence that organic and sustainable farming could offer better safety and quality in food products than conventional farming. Lairon (2011) also drew attention to organic food products that appeared to have less risk of causing food safety problems and better health benefits in the long-term. Asami et al (2003) remarked on the differences between organic, sustainable and conventional. The organic farming method seemed to have better nutritional quality and food safety than the sustainable and conventional farming methods, but had the lowest production of these three methods. On the other hand, conventional farming had the highest production but with lowest nutritional quality and food safety. Sustainable farming appeared to be in the balance of the other methods and was orientated to meet human food demands.

Furthermore, HACCP should also integrate in sustainable farming for ensuring food safety, because HACCP focuses on any deviation that can affect food safety and cause human harm. Although sustainable and organic farming methods may be safer on the food product

quality than conventional farming methods, they may not remove the possibility of food safety issues occurring such as foodborne diseases and cross-contamination. However, HACCP could assist in reducing the possibility of the occurrence of food safety issues.

#### **4.7 The big picture of food in the sustainable future**

Human beings live in a circular ecological system. No matter how we treat this system, the system will treat us back in the same way, directly or indirectly. Food is one of the essential sources we require to survive. To obtain sufficient and safe food human utilises various systems and knowledge. Currently, the global climate issues and the increasing world population are setting a huge challenge to human survival. How can humans produce enough food to feed the gigantic and growing world population under the climate change? The current conventional farming methods might achieve this goal with some environmental scarifies. Hence, a more organic and environmentally-friendly farming method should be encouraged to be developed in order to reach a sustainable development of human survival. Furthermore, not only the food production needs to be transformed, but also various steps along the food chain require various transformations to achieve sustainable development.

Firstly, in the case of the pilot study, food leftovers can still be seen as edible food although food safety can be a problem for leftovers. The treatment before eating the leftovers, the expiry date of leftovers, the storage method of leftovers before eating, and other aspects could affect the food safety of these leftovers. However, if consumers do not take away their leftovers from restaurants, they become waste and might affect our environment negatively, in ways such as greenhouse gas emission. The food waste may be used as feedstock for biofuel or may transform into soil. From food leftovers to the next meal or to biofuel feedstock, these transformations would also require the support of politics in order to succeed. This support

might include establishing social norms, personal norms and even other factors such as education that could influence attitudes towards taking away food leftovers in restaurants.

Moreover, the food leftovers problem is merely a small part of the global food system. Food itself should be prioritised for human nutritional requirements and should be controlled for food safety. At the same time, food waste management should be implemented from the beginning of food production, which would require better planning, require increasing efficiency, and to follow the six approaches in the hierarchy of food waste management. Due to the hunger problem in the global population, when food is edible, it does not seem to be moral and ethical to use it for producing biofuel. However, when the food becomes waste, it should be utilised for producing energy for the needs of modern human life. Food politics on the other hand should act as a framework to coordinate and manage food resources during different stages of the human food chain. Additionally, it should guide the attitudes of the food consumer towards food resources by influencing the relevant contributors to these attitudes and should practice environmentally friendly behaviours in dealing with food resources.

In summary, the food system for feeding an extra three billion in next 90 years is a system that may require a collaboration between energy, food safety, waste, and politics. Individual consumers should be included at all stages, because human survival will come down to individual efforts.

## **4.8 Conclusion**

This thesis has demonstrated the urgency of food management issues. The main structured or organised work to do with food security, waste, and safety issues has been stated but there is much more. Future action ought to involve establishing social norms of sustainable food management, changing to a rather favourable attitude toward sustainable

food management, and forming behaviours and habits of making sustainable food consumption choices.

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## 6 Appendix

# FOOD WASTE IN RESTAURANTS

## QUESTIONNAIRE SURVEY

The purpose of this survey is to investigate Norwegian consumers' attitudes towards leftover food waste in restaurants and to identify factors that influence the management of food waste. The results of the survey will be used in my Master's thesis in Risk psychology, Environment and Safety (RIPENSA) at the Norwegian University of Science and Technology (NTNU).

Participation in the survey is voluntary, and all who participate are anonymous. You will not be asked to give any personal identification information. The results will be presented in such a way that no individual respondents may be recognised.

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Answering the questions takes about 15 to 20 minutes. Please respond once only to this survey.

Thank you for being willing to participate in the survey.

Yunjie Lu  
RIPENSA Master's Degree Student  
Britt-Marie Drottz Sjöberg  
Professor, Academic Supervisor

 **NTNU**  
Innovation and Creativity  
Department of Psychology

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**D3.** Taking away leftovers of ordered food from a meal in an *expensive* restaurant is ... ⇨

Mark one box per line.

	Strongly disagree 1	Dis-agree 2	Neither /nor 3	Agree 4	Strongly agree 5
1. ... greedy.....	<input type="checkbox"/>				
2. ... shameful .....	<input type="checkbox"/>				
3. ... wasteful.....	<input type="checkbox"/>				
4. ... effective .....	<input type="checkbox"/>				
5. ... economic .....	<input type="checkbox"/>				
6. ... environmentally friendly..	<input type="checkbox"/>				
7. ... smart.....	<input type="checkbox"/>				
8. ... inconvenient.....	<input type="checkbox"/>				

**E.** Considering the *Norwegian context*, to what extent you agree or disagree with the following statements? Mark one box per line.

	Strongly disagree 1	Dis-agree 2	Neither /nor 3	Agree 4	Strongly agree 5
1. Food waste in restaurant is not my concern .....	<input type="checkbox"/>				
2. Taking away leftovers of ordered food in a restaurant is not my «style» .....	<input type="checkbox"/>				
3. Due to my principles, I feel personally obliged to take home food leftovers from restaurants.....	<input type="checkbox"/>				
4. In my opinion, all municipalities should have wet organic waste trash bins for restaurants.....	<input type="checkbox"/>				
5. My personal view is that all restaurants should offer food leftovers take away opportunities .....	<input type="checkbox"/>				
6. In my opinion, making a weekly plan of all dinner meals helps to reduce food waste in a household .....	<input type="checkbox"/>				
7. From my point of view, it is important that people care about food waste even if they can afford not to care .....	<input type="checkbox"/>				
8. As I see it, food waste is not a big problem compared to other waste problems.....	<input type="checkbox"/>				
9. In my opinion, everyone should be taught to manage food waste better.....	<input type="checkbox"/>				
10. My opinion is that food wastes should always be treated separately from other types of wastes.....	<input type="checkbox"/>				
11. I often use or eat food even after its expiry date.....	<input type="checkbox"/>				
12. Personally, I think it is more acceptable to take away food leftovers from a restaurant when eating alone than when eating with others.....	<input type="checkbox"/>				
13. The idea of not wasting food in a restaurant is solidly anchored in my value system ..	<input type="checkbox"/>				
14. I would be willing to have better food waste management when better methods are available .....	<input type="checkbox"/>				
15. Due to values important to me, I feel obliged not to waste food in restaurants.....	<input type="checkbox"/>				
16. I think parents should teach children not to waste food .....	<input type="checkbox"/>				
17. From my point of view, most of the food waste in restaurants is avoidable .....	<input type="checkbox"/>				

**F.** To what extent you agree or disagree with the following statements? *Mark one box per line.*

Strongly disagree  
1

Dis-agree  
2

Neither /nor  
3

Agree  
4

Strongly agree  
5

- |     |   |                          |                          |                          |                          |                          |
|-----|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1.  | My friends think it is stupid to put much time or effort into food waste management..   | <input type="checkbox"/> |
| 2.  | The seriousness of climate change will soon force people to care more about environmental issues .....  | <input type="checkbox"/> |
| 3.  | We should not waste food under any circumstances.....   | <input type="checkbox"/> |
| 4.  | It is polite manner to eat up all ordered food in a restaurant.....   | <input type="checkbox"/> |
| 5.  | It is unusual to ask for take away leftover food from an ordered meal in an expensive restaurant .....  | <input type="checkbox"/> |
| 6.  | Norwegian society is more concerned about e.g. energy efficiency than food waste management efficiency.....   | <input type="checkbox"/> |
| 7.  | You are expected to finish everything on the plate that you order in a restaurant .....   | <input type="checkbox"/> |
| 8.  | I have experienced that people I dine out with take home food leftovers in not-so-expensive restaurants.....  | <input type="checkbox"/> |
| 9.  | People who are important to me expect that I do not take home food leftovers .....  | <input type="checkbox"/> |
| 10. | I have seen other customers taking home food leftovers in an expensive restaurant ..  | <input type="checkbox"/> |
| 11. | You should take away edible food leftovers of an ordered meal from any type of restaurant .....   | <input type="checkbox"/> |
| 12. | We should have more food waste management campaigns to increase environmentally friendly behaviour .....  | <input type="checkbox"/> |
| 13. | Norwegians take away leftover food from an ordered meal in not-so-expensive restaurants in Norway.....  | <input type="checkbox"/> |
| 14. | It is unusual to ask for take away leftover food from an ordered meal in a not-so-expensive restaurant .....  | <input type="checkbox"/> |
| 15. | It is impolite to leave leftover food on the plate when one is invited to a friend's home-cooked dinner.....  | <input type="checkbox"/> |
| 16. | People who are important to me support me when I take home food leftovers .....   | <input type="checkbox"/> |
| 17. | A person who takes away leftover food from an ordered meal in a restaurant would be viewed by most people as someone without economic resources ..... | <input type="checkbox"/> |
| 18. | I have experienced that people in other countries take home food leftovers .....  | <input type="checkbox"/> |
| 19. | People who are important to me suggest that I should not waste food in restaurants .  | <input type="checkbox"/> |
| 20. | I have experienced that people I dine with take home food leftovers in an expensive restaurant .....  | <input type="checkbox"/> |
| 21. | People should care about food waste.....  | <input type="checkbox"/> |
| 22. | It is acceptable to leave leftover food on the plate at a family home-cooked dinner...  | <input type="checkbox"/> |
| 23. | Norwegians take away leftover food from an ordered meal in not-so-expensive restaurants <i>outside</i> Norway .....                                   | <input type="checkbox"/> |
| 24. | In Norway, it is acceptable not to take away leftover food from an ordered meal in a restaurant .....   | <input type="checkbox"/> |
| 25. | Taking away leftover food from an ordered meal in a not-so-expensive restaurant is impolite.....  | <input type="checkbox"/> |
| 26. | People from <i>non-Norwegian</i> cultures may be more willing to take away leftover food from an ordered meal in a not-so-expensive restaurant .....  | <input type="checkbox"/> |
| 27. | I have seen other customers taking home food leftovers in not-so- expensive restaurants.....  | <input type="checkbox"/> |
| 28. | I have myself taken food leftovers home when I was in another country.....  | <input type="checkbox"/> |

## G. YOUR PERSONAL EXPERIENCE

1. During *your entire lifetime*, how often have you experienced the following? *Mark one box per line.*
- |  | Never<br>1               | 1 - 2<br>times<br>2      | 3 - 4<br>times<br>3      | 5 - 6<br>times<br>4      | Over 6<br>times<br>5     |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Being asked by restaurant staff if you would like to take food leftovers home.....                                | <input type="checkbox"/> |
| 2. Taking home a large portion of food leftovers from a restaurant meal.....   | <input type="checkbox"/> |
| 3. Leaving quite a lot of food on your plate when dining out, and wanting to take them home (but did not do so)..... | <input type="checkbox"/> |
| 4. Being taught by your parents not to waste food.....   | <input type="checkbox"/> |
| 5. Leaving quite a lot of food on your plate when dining out, but <i>not</i> wanting to take them home.....          | <input type="checkbox"/> |
| 6. Using a «doggy bag» / food container to take food leftovers home from a restaurant...                             | <input type="checkbox"/> |
2. During *the last year (the last twelve months)*, how often have you experienced the following? *Mark one box per line.*
- |   | Never<br>1               | Rarely<br>2              | Some<br>times<br>3       | Often<br>4               | Very<br>often<br>5       |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. I have been asked by friend(s) to bring some leftovers for them when eating out.....                           | <input type="checkbox"/> |
| 2. I have been requested to bring home with me leftover food from a home-cooked dinner at my parents' house ..... | <input type="checkbox"/> |
| 3. I treat food waste separately from other wastes when recycling at home.....                                    | <input type="checkbox"/> |
| 4. I have been asked to take home with me leftover food from a home-cooked dinner at a friend's house .....       | <input type="checkbox"/> |
| 5. My friends took away food leftovers when we dined out.....   | <input type="checkbox"/> |

## H. YOUR KNOWLEDGE ABOUT WASTE AND ENVIRONMENT MANAGEMENT

Please answer «True» or «False» to each of the following statements. *Mark one box per line.*

- |   | True<br>1                | False<br>2               |
|---|--------------------------|--------------------------|
| 1. When used for the same period of time, traditional light bulbs save more energy than LED light bulbs.....                          | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. The total volume of waste in Norway has decreased in the last decade .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. In 2010, Norway invested more in renewable energy resources than other European countries .....                                    | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. In general, less than one fifth of food products we buy are not consumed .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. «Reduce, recover and recycle» are the three main steps of waste management strategies internationally...                           | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Nuclear power is a type of renewable energy.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Solar power, wind power and marine power do produce environmentally friendly energy .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. China is currently ranked at the first place of renewal-energy-resource national investors among UN member countries in 2010 ..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Landfilling food waste does not release CO <sub>2</sub> .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Between 10 and 20 percent of all fish caught by European fishing industries is wasted today .....                                 | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. In Norway, all food waste is used for animal feeding.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. When run under the same conditions, electric cars emit less CO <sub>2</sub> than cars using other fuels .....                     | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. All Norwegian municipalities have organic waste trash bins for residents .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. In 2008, the total amount of wet organic waste generated in Norway was approximately 1.8 million tons...                          | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. In Norway, about 50% of all kinds of waste is recovered as new energy .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. «SmartCity Trondheim» is a project about better efficiency of waste handling.....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. When it comes to disposing of perfectly edible food, USA is the least wasteful country .....                                      | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. The only consequence of Climate change today is that the temperature on the earth increases.....                                  | <input type="checkbox"/> | <input type="checkbox"/> |

# FOOD WASTE IN RESTAURANTS

## QUESTIONNAIRE SURVEY

The purpose of this survey is to investigate Norwegian consumers' attitudes towards leftover food waste in restaurants and to identify factors that influence the management of food waste. The results of the survey will be used in my Master's thesis in Risk psychology, Environment and Safety (RIPENSA) at the Norwegian University of Science and Technology (NTNU).

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**D3.** Taking away leftovers of ordered food from a meal in an *expensive* restaurant is ... ⇨

Mark one box per line.

	Strongly disagree 1	Dis-agree 2	Neither /nor 3	Agree 4	Strongly agree 5
1. ... greedy.....	<input type="checkbox"/>				
2. ... shameful .....	<input type="checkbox"/>				
3. ... wasteful.....	<input type="checkbox"/>				
4. ... effective .....	<input type="checkbox"/>				
5. ... economic .....	<input type="checkbox"/>				
6. ... environmentally friendly..	<input type="checkbox"/>				
7. ... smart.....	<input type="checkbox"/>				
8. ... inconvenient.....	<input type="checkbox"/>				

**E.** Considering the *Norwegian context*, to what extent you agree or disagree with the following statements? Mark one box per line.

	Strongly disagree 1	Dis-agree 2	Neither /nor 3	Agree 4	Strongly agree 5
1. As I see it, food waste is not a big problem compared to other waste problems.....	<input type="checkbox"/>				
2. Due to my principles, I feel personally obliged to take home food leftovers from restaurants.....	<input type="checkbox"/>				
3. The idea of not wasting food in a restaurant is solidly anchored in my value system ..	<input type="checkbox"/>				
4. In my opinion, making a weekly plan of all dinner meals helps to reduce food waste in a household .....	<input type="checkbox"/>				
5. I think parents should teach children not to waste food .....	<input type="checkbox"/>				
6. Due to values important to me, I feel obliged not to waste food in restaurants.....	<input type="checkbox"/>				
7. In my opinion, everyone should be taught to manage food waste better.....	<input type="checkbox"/>				
8. I would be willing to have better food waste management when better methods are available .....	<input type="checkbox"/>				
9. I often use or eat food even after its expiry date.....	<input type="checkbox"/>				
10. From my point of view, it is important that people care about food waste even if they can afford not to care.....	<input type="checkbox"/>				
11. Food waste in restaurant is not my concern .....	<input type="checkbox"/>				
12. My personal view is that all restaurants should offer food leftovers take away opportunities.....	<input type="checkbox"/>				
13. From my point of view, most of the food waste in restaurants is avoidable.....	<input type="checkbox"/>				
14. My opinion is that food wastes should always be treated separately from other types of wastes.....	<input type="checkbox"/>				
15. Taking away leftovers of ordered food in a restaurant is not my «style» .....	<input type="checkbox"/>				
16. Personally, I think it is more acceptable to take away food leftovers from a restaurant when eating alone than when eating with others.....	<input type="checkbox"/>				
17. In my opinion, all municipalities should have wet organic waste trash bins for restaurants.....	<input type="checkbox"/>				

**F.** To what extent you agree or disagree with the following statements? *Mark one box per line.*

Strongly disagree  
1

Dis-agree  
2

Neither /nor  
3

Agree  
4

Strongly agree  
5

- |     |   |                          |                          |                          |                          |                          |
|-----|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1.  | You are expected to finish everything on the plate that you order in a restaurant .....   | <input type="checkbox"/> |
| 2.  | I have experienced that people I dine with take home food leftovers in an expensive restaurant .....  | <input type="checkbox"/> |
| 3.  | It is impolite to leave leftover food on the plate when one is invited to a friend's home-cooked dinner .....   | <input type="checkbox"/> |
| 4.  | In Norway, it is acceptable not to take away leftover food from an ordered meal in a restaurant .....   | <input type="checkbox"/> |
| 5.  | It is unusual to ask for take away leftover food from an ordered meal in a not-so-expensive restaurant .....  | <input type="checkbox"/> |
| 6.  | People from <i>non-Norwegian</i> cultures may be more willing to take away leftover food from an ordered meal in a not-so-expensive restaurant .....  | <input type="checkbox"/> |
| 7.  | My friends think it is stupid to put much time or effort into food waste management..   | <input type="checkbox"/> |
| 8.  | A person who takes away leftover food from an ordered meal in a restaurant would be viewed by most people as someone without economic resources ..... | <input type="checkbox"/> |
| 9.  | I have myself taken food leftovers home when I was in another country .....   | <input type="checkbox"/> |
| 10. | Norwegians take away leftover food from an ordered meal in not-so-expensive restaurants in Norway .....   | <input type="checkbox"/> |
| 11. | It is polite manner to eat up all ordered food in a restaurant.....   | <input type="checkbox"/> |
| 12. | Norwegian society is more concerned about e.g. energy efficiency than food waste management efficiency .....  | <input type="checkbox"/> |
| 13. | It is acceptable to leave leftover food on the plate at a family home-cooked dinner...  | <input type="checkbox"/> |
| 14. | People should care about food waste.....  | <input type="checkbox"/> |
| 15. | People who are important to me suggest that I should not waste food in restaurants .  | <input type="checkbox"/> |
| 16. | People who are important to me support me when I take home food leftovers .....   | <input type="checkbox"/> |
| 17. | I have experienced that people I dine out with take home food leftovers in not-so-expensive restaurants.....  | <input type="checkbox"/> |
| 18. | We should have more food waste management campaigns to increase environmentally friendly behaviour .....  | <input type="checkbox"/> |
| 19. | You should take away edible food leftovers of an ordered meal from any type of restaurant .....   | <input type="checkbox"/> |
| 20. | I have seen other customers taking home food leftovers in not-so- expensive restaurants.....  | <input type="checkbox"/> |
| 21. | We should not waste food under any circumstances.....   | <input type="checkbox"/> |
| 22. | It is unusual to ask for take away leftover food from an ordered meal in an expensive restaurant .....  | <input type="checkbox"/> |
| 23. | People who are important to me expect that I do not take home food leftovers .....  | <input type="checkbox"/> |
| 24. | Taking away leftover food from an ordered meal in a not-so-expensive restaurant is impolite.....  | <input type="checkbox"/> |
| 25. | Norwegians take away leftover food from an ordered meal in not-so-expensive restaurants <i>outside</i> Norway .....                                   | <input type="checkbox"/> |
| 26. | I have experienced that people in other countries take home food leftovers.....   | <input type="checkbox"/> |
| 27. | The seriousness of climate change will soon force people to care more about environmental issues .....  | <input type="checkbox"/> |
| 28. | I have seen other customers taking home food leftovers in an expensive restaurant..   | <input type="checkbox"/> |

## G. YOUR PERSONAL EXPERIENCE

1. During *your entire lifetime*, how often have you experienced the following? *Mark one box per line.*
- |  | Never<br>1               | 1 - 2<br>times<br>2      | 3 - 4<br>times<br>3      | 5 - 6<br>times<br>4      | Over 6<br>times<br>5     |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. Being taught by your parents not to waste food.....   | <input type="checkbox"/> |
| 2. Using a «doggy bag» / food container to take food leftovers home from a restaurant...                             | <input type="checkbox"/> |
| 3. Leaving quite a lot of food on your plate when dining out, and wanting to take them home (but did not do so)..... | <input type="checkbox"/> |
| 4. Taking home a large portion of food leftovers from a restaurant meal.....   | <input type="checkbox"/> |
| 5. Leaving quite a lot of food on your plate when dining out, but <i>not</i> wanting to take them home.....          | <input type="checkbox"/> |
| 6. Being asked by restaurant staff if you would like to take food leftovers home.....                                | <input type="checkbox"/> |
2. During *the last year (the last twelve months)*, how often have you experienced the following? *Mark one box per line.*
- |   | Never<br>1               | Rarely<br>2              | Some<br>times<br>3       | Often<br>4               | Very<br>often<br>5       |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. My friends took away food leftovers when we dined out.....   | <input type="checkbox"/> |
| 2. I have been requested to bring home with me leftover food from a home-cooked dinner at my parents' house ..... | <input type="checkbox"/> |
| 3. I have been asked to take home with me leftover food from a home-cooked dinner at a friend's house .....       | <input type="checkbox"/> |
| 4. I have been asked by friend(s) to bring some leftovers for them when eating out.....                           | <input type="checkbox"/> |
| 5. I treat food waste separately from other wastes when recycling at home.....                                    | <input type="checkbox"/> |

## H. YOUR KNOWLEDGE ABOUT WASTE AND ENVIRONMENT MANAGEMENT

Please answer «True» or «False» to each of the following statements. *Mark one box per line.*

- |   | True<br>1                | False<br>2               |
|---|--------------------------|--------------------------|
| 1. When it comes to disposing of perfectly edible food, USA is the least wasteful country .....                                       | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. «Reduce, recover and recycle» are the three main steps of waste management strategies internationally...                           | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. «SmartCity Trondheim» is a project about better efficiency of waste handling.....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. In 2008, the total amount of wet organic waste generated in Norway was approximately 1.8 million tons...                           | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. China is currently ranked at the first place of renewal-energy-resource national investors among UN member countries in 2010 ..... | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. All Norwegian municipalities have organic waste trash bins for residents .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. In general, less than one fifth of food products we buy are not consumed .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. The only consequence of Climate change today is that the temperature on the earth increases.....                                   | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Between 10 and 20 percent of all fish caught by European fishing industries is wasted today .....                                  | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. When used for the same period of time, traditional light bulbs save more energy than LED light bulbs.....                         | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. In 2010, Norway invested more in renewable energy resources than other European countries .....                                   | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. In Norway, about 50% of all kinds of waste is recovered as new energy .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. In Norway, all food waste is used for animal feeding .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. Solar power, wind power and marine power do produce environmentally friendly energy .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. The total volume of waste in Norway has decreased in the last decade .....  | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. Landfilling food waste does not release CO <sub>2</sub> .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Nuclear power is a type of renewable energy .....   | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. When run under the same conditions, electric cars emit less CO <sub>2</sub> than cars using other fuels .....                     | <input type="checkbox"/> | <input type="checkbox"/> |