Opposing Expectations: Why Food Waste Remains a Problem in Cologne

An Institutional Network Analysis on Food Waste in Germany

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Executive Summary

Food waste remains a large problem globally, not only in the light of global greenhouse gas emissions, but also in the light of decreasing resource availability. Research in this area has so far mainly focused on behavioral factors influencing production of food waste, while the formal and informal institutions that relate to the management of waste play an equally important role in shaping individual and company behavior. This research focuses on how food waste can be better managed among students, one of the biggest food waste contributors in the national food waste account, and other actors, such as companies and supermarkets, which continuously produce a lot of food waste. Accordingly, this thesis asks as a main research question: *How do Institutional Barriers and Drivers influence the Food Waste Management of Students and Food Waste Initiatives in Cologne?*

The case study is the city of Cologne, Germany. The city of Cologne has been chosen as a single-case study due to the fact that it is one of the largest student cities in Germany and also home to many companies and initiatives that are engaging in reducing food waste. Data is collected through literature search, interviews and student surveys. The interviews have been conducted with nine different actors from food waste initiatives, supermarkets or associations. The data from the interviews has ben anonymized for the purposes of this thesis. The research follows an inductive and qualitative approach, which is why the survey that is collecting data from students is not used for statistical analysis. The aim is to find the drivers and barriers for food waste and develop a theory in the best case from it.

This research captures the informal institutions (i.e. norms, rules and strategies) that shape student behavior, in conjunction with the strategies of different waste companies and initiatives. These informal institutions are analyzed within the framing of formal rules and regulations relating to food waste. The institutional network analysis (INA) approach that is built on the Institutional Analysis Development (IAD) framework and Institutional grammar (IG) is used to relate all institutions together in one picture to identify potential institutional misalignments. The collected data from the literature, the interviews and the survey, is coded using the institutional grammar by Ostrom (1995). Additionally, this thesis develops the institutional grammar a little further by introducing some new elements. On the one hand survey data is used for the first time in the institutional network analysis, which overall gives the network analysis more credibility through a larger data base. On the other hand, expectations have been introduced to the networks as a new element next to rules, norms and strategies. By using the institutional grammar according to Ostrom (1995), five action situations were identified. Action situations, or action arenas are situations in which rules, norms and strategies through conflicts form actor's behavior. The action situations that were identified in this research encompass *Waste Prevention, Waste Disposal, Waste Treatment, Sustainability Understanding and Best-Before Date*. The action situations were defined according to the waste hierarchy of German Law and the findings of the institutional network analysis.

Next to the institutional network analysis, a descriptive analysis helps identifying patterns from the collected data, which in turn helps embedding the results of the network analysis into a broader context. The descriptive analysis takes into account all gathered data that cannot be used for the institutional network analysis, but which can still provide important insights into the problem. Last, another more descriptive section provides an overview about the current German food waste management system, to be able to understand later on which parts would need improvement.

The main finding of this study is that opposing expectations about how to effectively reduce food waste by the different actors mirror a general awareness on food waste in Cologne, but also reveal a lack of rules and norms in the area of food waste management. Moreover, the combined results of the network analysis and the general observations show that institutional misalignments among expectations are often not resolved through actor's engaging in trying to prevent food waste. The

actors in contrast are remaining rather inactive and seemingly hope that the government finds solutions for their expectations. To remove the barriers to improve the food waste management in Cologne even further, nine policy recommendations were formulated. The recommendations are based on the findings of this study, but are also subject to limitations, which could not have been further investigated in this thesis.

One of the main takes aways of this study is that seemingly more orientation and clearer rules are needed for many actors, which have to come from the government. Only providing information events and education is not enough to reduce food waste, but clear regulations for customers and retail are needed. This can be achieved through providing clearer framework conditions for all actors could lead to the development of societal norms and a common understanding of food waste as a pressing issue and resolve the differing expectations. Further research should therefore focus on further solutions for removing the misalignments of the actors.

Key Words: Food Waste, Waste Prevention, Waste Treatment, Waste Disposal, Institutional Network Analysis, Institutional Interdependencies, Cologne, Differing Expectations

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Chapter 1: Introduction

The relationship between climate change and food waste is twofold: On the one hand, food waste is responsible for 6% of the global GHG emissions. On the other hand, climate change has a great impact on landscapes and agriculture, thus the reduction of food waste and its related emissions automatically reduces the pressure on resource availability (Ritchie, 2021 & UNEP, 2022). Food Waste was part of the big issues that were addressed with the Paris Climate Agreement in 2015. Germany, which signed and ratified the treaty with its Sustainable Development Goals, is one of the biggest agricultural producers in the world. The country's total export value of agricultural products amounts to around 71 billion euros annually (Simpson, 2021). This is a lot, even compared to other countries, such as France, which is one of the largest producers of agricultural products in the EU and which exports "only" agricultural products worth 61 billion Euros ("Agri-food industry: total export value France 2020 | Statista", 2021).

These large amounts of food produced in Germany, also need to be effectively used. Regarding the per-capita food waste, numbers seem to be contradictory. While the local production of food remains on a high level, on average around 75 kilograms of food waste is generated per capita each year according to Statista (2021). This is a rather low value within the European Union (EU) and is striking, as food prices in Germany remain to be rather on the cheap side, which could normally lead to people buying more than needed (Eurostat, 2022). While in Germany in 2019, around 61% of the food waste generated came from private households (Vowell, 2019), around 17% came from large consumers and the industry. Only 6% in contrast to that could be attributed to supermarkets (Figure 57 in Appendix B). In contrast to Statista, Vowell (2019) found out that the average German has a per-

capita food waste of 82 kg per year. Vowell claims that "waste, with the inclusion of food waste is a clear issue in Germany, especially when compared to other members of the EU (Eurostat, 2019; in Vowell, 2019). The unclarity about how much food is actually wasted, next to Germany's large agricultural output and a general awareness on food waste in society make it an interesting case to study. Cologne, which is one of the largest (student) cities in Germany and which is home to many companies and initiatives that are engaged in reducing food waste, is selected as a case study, to investigate the food waste issue more in detail.

There are not many studies on food waste behavior in Germany, but the few that exist point out that single person households and people aged between 18 and 30 years are one of the highest contributors to food waste (Jörissen et al. 2015). This finding was complemented by a Scottish study that showed that students and especially the age group between 18- and 34-years waste proportionally the most food (Acheson, 2020). It can be said that the literature on student's food waste behavior is a little contradictory. While on the one hand there is only little data on food waste among German students in general, no study could be found on the interactions between students and other actors, such as canteens, supermarkets, or food waste initiatives that are all aiming at reducing food waste. Gabriel et al. (2021) claim that more research needs to be done on the "general involvement in issues related to food waste and the students' general awareness of food waste as a problem (p. 965)." Since the general food waste behavior seems to correlate with awareness about the impacts on food waste and the resulting involvement, this thesis explores the food waste behavior of German students, to see how awareness and improvements in the food waste behavior especially in the interplay with other actors can be achieved.

To start with, students are an interesting and relevant case for this study, as they constitute a large part of society, and they are normally well educated. This contradiction between their higher food waste and their higher education status makes them an important and relevant group to study, since it can be assumed that higher educated people are more aware of environmental impacts of food waste. In contrast to students, supermarkets and other actors are also important to consider, as they often throw away food that is still edible and that might be lacking for people that cannot afford buying food. However, students do navigate in an environment of rules and values and develop strategies to address food waste. They do so in interaction with other actors and negotiate the rules and values within these networks. This study will therefore address the gap in the literature on food waste behavior of German students, while also contributing to the literature on students' role within a network of institutions of different actors (Mesdaghi, Ghorbani, de Bruijne, 2021). Understanding the rules and values the different actors have, can eventually help aligning them and therefore reducing food waste overall.

This study therefore investigates the food waste behavior of students in Cologne, while also considering political influence on this behavior through laws and regulations. Accordingly, an analysis of different food waste initiatives, companies and gastronomy is done, to understand how their institutions can be aligned and food waste can be even better prevented, to answer the main research question: *How do Institutional Barriers and Drivers influence the Food Waste Management of Students and Food Waste Initiatives in Cologne?* To analyze the rules, values and strategies of students, companies, supermarkets and food waste initiatives, an institutional network analysis according to Ostrom (1995) is used to be able to identify the underlying institutional patterns in this network and make subsequently use of this knowledge to formulate political advice on how to improve the food waste situation. Cologne as the fourth biggest city in Germany is selected as a case study, to be able to generate policy advise and potentially be able to apply it to other regions in Germany, or in other countries as well. Cologne has been selected due to the fact that it is one of the biggest student cities in Germany, while there are also many companies and food waste initiatives that aim at reducing food

waste. Additionally, North Rhine Westphalia, the state in which Cologne is located, is together with Bavaria, Saxony and Baden-Württemberg a pioneer in food waste management according to Friedrich and Ernst (2018).

Given the points above, this thesis aims at answering the main research question in different steps. First, an extensive literature review is provided to show the status quo of research on food waste in general, but also in Germany specifically. Secondly, a more thorough explanation about the methodology that is used is provided, meaning the Institutional Grammar by Ostrom. Third, to provide relevant background information for the subsequent analysis of the food waste management system in Cologne, chapter 3 gives an insight into the current regulations, laws and organization of the food waste management in Cologne. Fourth, the results chapter presents general results from the survey, the literature research, and the interviews. Next to the general results are also the institutional network results presented, which are discussed in chapter five. Last, the research questions are answered, and policy recommendations are provided that could help to improve the food waste management in Cologne even further. Figure 1 additionally summarizes the research plan of this thesis, which steps were taken in which phase to be able to answer the main research question.

1.1. Problem Statement

As the sections above have shown, food waste remains a big problem for the climate and the environment. Especially the consumers are proportionally the largest contributors to food waste. Recent research has found that among the consumers, students are proportionally among the biggest contributors to food waste. On the other hand, producers also have their share of the problem. Therefore, it is necessary to have a closer look both at consumers individually, especially students, but also the supermarkets, companies and initiatives that are dealing with the issue.

1.2. Research Gap

As the literature review has shown, a small contradiction exists in the literature about the role of students in food waste. While Acheson (2021) in her Scottish study found that students are contributing proportionally more to food waste, Gabriel et al. (2020) found in their German study on food waste behavior that students were quite aware of the topic of food waste and even some saw themselves as more efficiently dealing with food waste. This view is contrasted by Broshuis (2021), who talks about the lack of awareness and general involvement of students in topics around food waste. This can be seen as the first literature gap that this paper seeks to fill. Since there are seemingly contrasting opinions, this research is diving into the extent to which German students are contributing to food waste, to get a better overview about the situation in Germany. Since there is only limited data on the food waste behavior of students in Germany, this research brings more clarity into the food waste situation among German students.

To continue, the above sections have shown that data on food waste behavior of students, especially their norms and strategies is lacking. Nonetheless, data is also lacking regarding the role of different actors in the food waste behavior of the students. Since around 25% of the food waste produced in Germany comes from wholesale and industry, it is crucial to also investigate the rules, norms and strategies of supermarkets, companies, and initiatives to see, if there might be barriers or drivers for reducing food waste. As this has not been done in conjunction with students, a second literature gap can be identified here. The studies that have been done on food waste in Germany so far mostly examined food waste behavior of actors more in isolation and more from a statistical point of view. Looking at all the actors in one network therefore poses a great research opportunity, to see how the interplay between these actors regarding food waste works and how it might be improved to even further lower food waste of students. Accordingly, this thesis attempts to answer the research

question: *How do Institutional Barriers and Drivers influence the Food Waste Management of Students and Food Waste Initiatives in Cologne?*

To close the literature gap on investigating the actors in conjunction and to answer the main research question and an Institutional Network Analysis according to Ostrom (1995) is performed to find out about the rules, norms and strategies that hold this network of actors together. Institutions are, to put the analytical method a little bit into context, defined by Ostrom as "rules, norms, and strategies that are created and changed through human interactions in frequently occurring or repetitive situations" (2011, in Mesdagi, Ghorbani, de Bruijne, 2021; p. 121). Looking at all the rules, norms and strategies of the different actors can help identifying institutional barriers, but also drivers for food waste reduction in Germany. Since rules, norms and strategies are such an important and inherent part of societies, which determined hoe most people in that society behave, it is elementary to get a close-up look on them. In order to answer the main research-question this paper uses six sub-questions that help identifying the barriers and drivers, which are presented below.

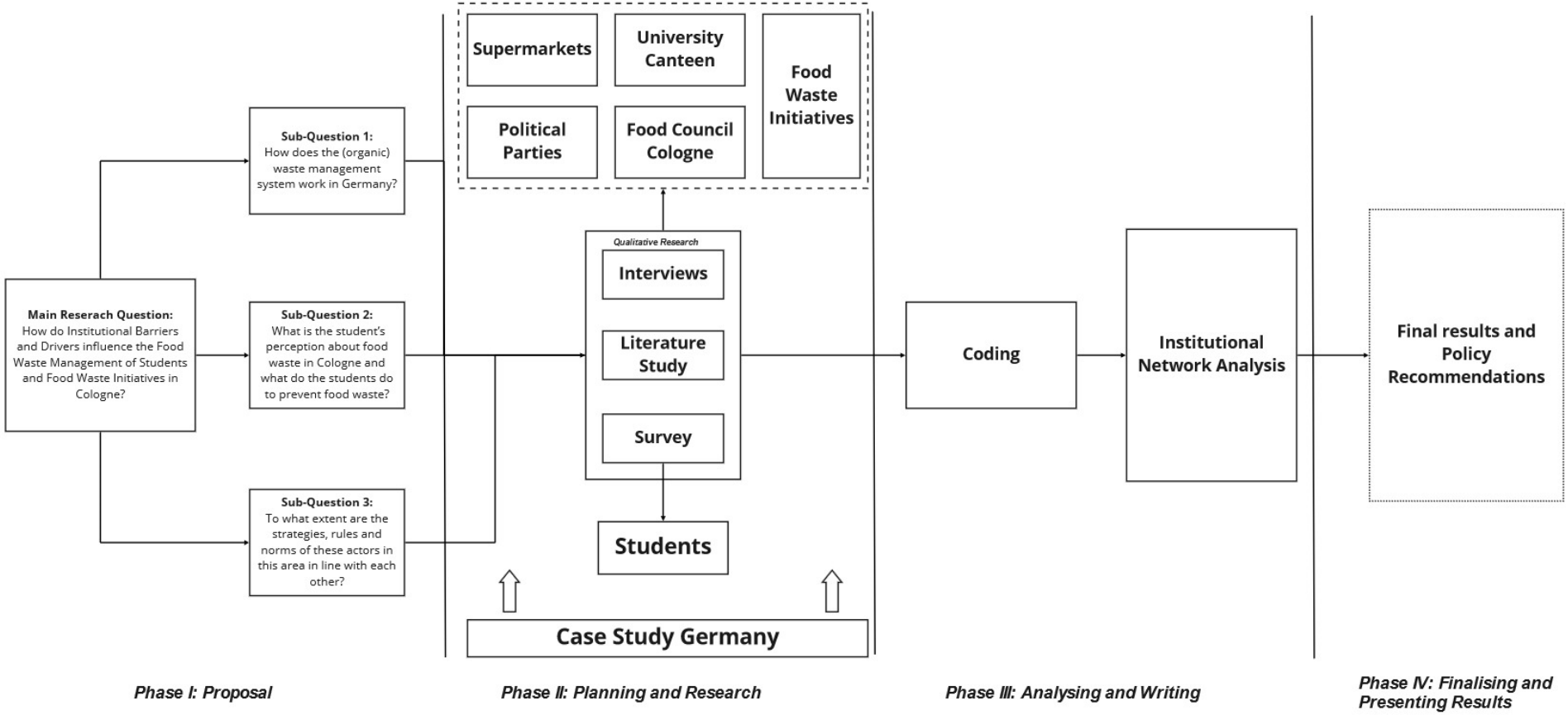

Figure 1: The Research Plan

1.3. Literature Review

In order to be able to answer the research questions above, first an overview about the most important literature on food waste in Germany and Institutional Network Analysis has to be provided to show the status quo. While there is some literature on student's behavior on food waste in different countries, studies including several actors, such as companies and food waste initiatives are still rather rare. The initiatives that are taken into account for this study include among other things the food bank, solidarity farming and food sharing. These are only some of the initiatives that exist in cologne and that aim at reducing food waste. A more comprehensive overview about all actors is provided in the actor analysis in chapter 2. The companies that were found throughout the research process, that also can be found in the actor map (Figure 3), are Too Good to Go, Gorillas and Hello Fresh, which all have to a different degree as their aim reducing food waste.

A recent study found that while the overall concept of this application is contributing to food waste reduction, it has rather less impact "on attitude, motivation or behavior change", as the people using the app already are motivated (van der Haar & Zeinstra, 2019, p. 6). Zeinstra et al. (2021) additionally found certain overall success factors and barriers for food waste initiatives. They found six crucial factors including "motivated individuals, awareness of the FW problem, collaboration, presence of resources (time, money, manpower), capabilities (skills, expertise and entrepreneurship) and sufficient communication within one's own organization, the collaboration and towards the outside world. (p. 36)". Furthermore, four key barriers were identified, including differing interests of stakeholders, a shortage of resources such as time, money, or manpower and uncertainties about commitment of stakeholders and their motivation to engage on a long term with the initiatives.

Reasons to Waste Food

To start with, Vowell (2019) found that vegetables and fruits are the mostly thrown away food items. Figure 48 (Appendix B) shows the shares of food that has been thrown away in Germany in the year 2015. The largest shares with 26% and 18% are vegetables and fruits. The third biggest category are baking goods, which probably refers to eggs, flour and other ingredients of cakes, bread and so on. The following abstract summarizes the most important research that has been done on the reasons why these types of food and food waste in general is produced.

While there is some research that showed that lack of awareness on food waste is an issue, Broshuis (2021) claims that little research has focused yet on why food is wasted, or more specifically the motivators and barriers related to food waste behavior especially among young people. Additionally, the author adds that it is crucial to further investigate the impact of the living conditions of students on their food waste behavior (p.26). This is especially interesting when looking at the socio-economic conditions of students at the different universities.

Jörissen et al. (2015) investigated household level food waste in Italy and Germany. The results they found in their study are diverse. While they found that mostly the type of foods that is wasted by the households are easily perishable items, such as fruits, vegetables or dairy products. The most common reason according to the authors to waste food were that the items had passed the best-before date, the items looked, smelled, tasted bad, the items were moldy, or the items remained too long in the fridge or cupboard. The most often mentioned drivers for food waste by the participants of the study were a too large packaging, a poor quality of the purchased goods, cooking too much due to a lack of experience, likes and dislikes of children and lack of time for the family management.

Furthermore, not only external, or psychological factors played a role in the people's food waste behavior, but also according to Lyndhurst (2007, in Graham-Rowe et al. 2014), people who see themselves as having rather bad cooking skills also reported higher amount of food waste. Exodus

(2007, in Graham-Rowe et al., 2014) added that people with a strong fear of food poisoning also reported higher amounts of food waste (p.20). Moreover, Vowell (2019) claims that food labelling misunderstanding also contributes to the waste of edible food in the household.

Limiting Food Waste

Next to the above-mentioned reasons to waste food, Vowell (2019) found in her study that consumer habits also play an important role. According to research by the Waste & Resources Action Program (WRAP) in the UK, personal choice and lifestyle also influence the food waste behavior of people. The psychological factors that were attributable to food waste behavior were according to the study motivation, willingness to act and one's daily home routine (p. 26). Gabriel et al. (2021) add to this that subjective norms have very little influence on food waste behavior, while personal and descriptive norms have a high influence. This means that one's attitude towards another person's food waste behavior could change more than one's attitude to another person's attitude to food waste. Moreover, Vowell (2019) claims that food labelling misunderstanding also contributes to the waste of edible food in the household.

Barriers to Minimizing Household Food Waste

One important barrier to reducing food waste that was found by Graham-Rowe et al. (2014) is that people want to be 'good providers', meaning that they want to provide healthy and abundant food for the family and guests (p.20). The ability to provide people with healthy and abundant food, as the authors explain can be interpreted with the symbolic ability to be able to protect and nurture the people. Furthermore, Graham-Rowe et al. (2014) mention that another barrier to reducing household food waste is inconvenience or laziness of people. Some people do bulk shopping to avoid going to the supermarket more often according to the authors (p. 21).

Drivers to Minimizing Household Food Waste

One of the drivers that is mentioned by Dittmar (2004, in Graham-Rowe, 2014) to potentially help reducing household food waste is to construct a sense of identity around the food item. As with other items that people purchase, people want to express with what they buy, who they are. Buying sustainable, more healthy food would mean that people express with this that they care about sustainability. Strengthening this behavior through rewards could be a way to make people behave more sustainable, also regarding food waste. Gabriel et al. (2021) claim that young people are affected more often by marketing and sales strategies that increase their food disposal amounts. In addition to this the most common applied prevention measures of food waste according to Jörissen et al. (2015) were optimized planning of meals, tailored food purchases, adequate storage and reus of leftovers and early childhood education on how to handle food.

Next to the more often named reasons for household-level food waste, Vowell (2019) mentions that wasting food is also an ethical issue to many people (p.3). It is argued that food consumption patterns in industrialized countries affect hunger and rural poverty in developing nations (Bräutigam et al., 2014). The "careless food handling in wealthy countries" would increase the global demand for food even more which would result in higher food prices of staple food on the world market, which would in turn again further weaken the purchasing power of poor people in developing nations. Graham-Rowe et al. (2014) came to a similar conclusion that food waste can evoke negative emotions, such as guilt.

Another important driver to reduce food waste is the economical aspect. According to Graham-Rowe et al. (2014), who refer themselves to the WRAP program of 2011, the purchase of food

with the subsequent throwing away, cost the average UK family an estimated 680 pounds per year. Especially for students, who are generally on the rather low-income side, this plays an important role.

Strategies to Reduce Food Waste

As the above-mentioned barriers, reasons and drivers for food waste, or its reduction respectively show, food waste is a highly complex topic. As it is the aim of this research, to shed more light upon the issue through an institutional point of view, recommendations are also formulated to give advice on this issue. In order to be able to see, if the recommendations that are being formulated in this research are similar to the recommendations of another research. This eventually helps providing a more universal picture on the whole issue and maybe be able to see larger patterns that emerge from this.

Chuah and Singh (2020) claim that development and enhancement of public awareness and engagement toward food waste problems should be promoted through "education and awareness campaigns" (p. 174). Raising awareness as the authors claim also has a lot to do with involvement and knowledge of individuals about food waste. It is explained that a more thorough knowledge on food waste behavior and disposal, such as waste separation should be enhanced through more regulatory enforcement (p. 175). Raising awareness on food waste can be done through information events and panel discussions at higher education institutions, or information posters about food waste could be displayed in canteens or on campus (Gabriel et al., 2021). Moreover, it is argued that primary and secondary school curricula should integrate subjects such as cooking, household management, or nutrition management to make people learn at an early stage in their lives how to be more resource efficient.

To continue, it should be mentioned that Germany has a strong need for improving their demand for "ugly" food, or more specifically the mentality and acceptance of people for "ugly" food (Vowell, 2019). Taking a look at Cologne it can be said that it was the first German city and the fourth in Europe that had a supermarket that was selling food that was considered as "ugly", since it was not fulfilling the quality standards. The supermarket that is called "the good food", offers customers all kinds of goods, which sometimes already have passed their best-before dates, but which are still edible. Consumers are able to decide themselves, how much they want to pay (Ruiz, 2017). Therefore, increasing these types of offers could be an additional strategy to reduce food waste even further.

Vowell (2019) mentions among other things four areas for acting on food waste. Firstly, a uniform food waste measurement should be introduced, as the measurements that have been done so far show different results. Secondly, Vowel claims that since 10% of the household food waste occurs due to a misunderstanding of food labels (European Commission, 2018), consumers must be "educated on food waste and on the implications of food waste" (p. 40). Third, economic instruments are mentioned as a further important leverage to reduce food waste among people. The author proposes an "Pay-as-You-Throw" (PAYT), meaning that households should be charged the amount of food waste that they produce, in weight, volume, or number of trash cans that they throw away (p.45).

Lastly, laws and regulations are mentioned as another tool to make retail and consumers reduce their food waste. Some of these measures are for example the inclusion of food waste measurements as part of corporate social responsibility, or the systematic replacement of the existing "expiration date" on the label with "to be consumed preferable by" (Malvezin, 2015; in Vowell, 2019). Since food waste does not only occur at the consumption stage, but also at the retail stage, Gabriel et al., (2021) advise that more sustainable sales strategies by the supermarkets must be developed to reduce the food waste in retail also considerably.

Role of Other Actors

Since this thesis is not only looking at student's food waste behavior, their rules, norms and strategies to avoid food waste, but also at food waste that is produced at the retail stage and initiatives that are trying to reduce food waste, a small insight has to be provided in this area. Alattar et al. (2020) mention in their study the important role of universities in tackling the food waste behavior of students. They claim that "Universities provide the structure and community (campus culture can be influenced and influence students) for implementing food-related programming, and students are at a prime life stage for change (p. 120)". This is well transferrable to Germany, where universities offer cheap cantina food that is often also wasted by students. That is why it is very important to also consider Universities as crucial actor. Gabriel et al. (2021) add that students that participated in their study generally showed a high interest in food topics and to prevent food waste. Moreover, the researchers found that the respondents of their study "view themselves as superior to others in dealing with food waste across all phases of consumption (p. 965)". This finding repeats the necessity of looking more in depth into the food waste behavior of (German) students, since there seems to be differing data on students' food waste behavior.

Institutional Grammar according to Ostrom (1995)

This study is taking an institutional point of view, by looking at the formal and informal rules, norms and strategies of the different actors. While "formal institutions are explicitly set by legislators and manifest themselves through laws, regulations, and protocols, informal institutions are more implicit, such as administrative practices, norms, professional codes, traditions, and customs (Juhola & Westerhof, 2011; Obeng & Agyenim, 2013, in Medaghi et al., 2018)".

Crawford and Ostrom (1995) categorize institutions within three "approaches". The *institutions-as-equilibria* approach, it is argued, is "the stability that can arise from mutually understood actor preferences and optimizing behavior" (p. 582). The other two approaches are the *institutions-as-norms* and *institutions-as-rules* approaches. These two approaches both "focus on linguistic constraints (spoken, written, or tacitly understood prescriptions or advice) that influence mutually understood actor preferences and optimizing behavior" (p. 582). To put it more concretely, Ostrom (2011, in Mesdaghi et al., 2021) defines institutions as rules, norms and strategies that are shaped through human interaction.

This paper focuses explicitly on both, formal and informal institutions, which can come into an institutional conflict situation according to Biesbroek et al. (2009, in Mesdaghi et al., 2022). These institutional conflicts occur when different actors at different levels adopt different strategies and structures to deal with a problem. This thesis is mainly concerned to find the underlying institutions of the different actors and identify institutional conflicts and how they can be resolved.

Institutional statements occur in so called 'action situations', which are defined by Ostrom (2005) as a social space, in which the participants with different interests interact, meaning exchanging goods and services, solving problems, or go into conflicts. In these action arenas or action situations, institutional conflicts occur, which should be detected by the researcher to draw conclusions how the interactions between actors can lead to new outcomes (Mesdaghi et al., 2021, p. 5). The action situations or social dilemmas between different institutions are normally analysed in network diagrams that show the different institutional statements and the best outcome situations.

The institutions can be extracted from interviews or official documents by using the Institutional Grammar introduced by Ostrom (1995). The Institutional Grammar (IG) with its ABDICO approach makes it possible to extract these Institutions through coding the documents. The different letters stand for:

A: Attribute *(the "who"—who does this statement refer to?)*

B: Object *(comes after verb)*

D: Deontic *(may, must, must not, should, should not)*

I: Aim *("what"—what is the statement about?)*

C: Condition *(under what conditions must the Aim occur?)*

O: Or Else *(sanction for not following a rule, norm, or strategy)*

The *Attribute* of an institutional statements asks for *who* this statement refers to. The attribute is often a person, or a company, or any other actor, but it does not have to be. The object always comes at the end of a statement and normally also is a person, or another actor. The deontic encompasses the binding nature of the institutional statement. Depending on if the institutional statement contains a may, must, should, must not etc., it is a norm or a rule. The *Aim* of the statement refers to what the statement is about, or what it *aims* to do. The *Aim* is normally the verb of the statement but can also include more elements. The *Condition* of the statement tells the researcher under what condition the norm, rule or strategy of the Institutional statement is working. If nothing is mentioned in the statement, then the institution normally always applies. Lastly, the *Or Else* means a potential sanction for the institution, which is normally stated in the institutional statement itself. If no sanction is explicitly mentioned in the statement, no sanction exists for this statement. A statement always has to have an Attribute [**A**], a Condition [**C**], an Aim [**I**] and an Object [**B**]. If these elements are present, the statement is a shared strategy. If the Institutional statement also contains a Deontic [**D**], then it is a norm. An institutional statement can only be considered a rule, if all the elements are in the statement, meaning if also a sanction [**O**] is part of the statement.

Figure 2: Example of an institutional Statement (Rule) Coded and visualized with Miro

1.4. Research Objective and Questions

1.4.1. Research Objective

Given the research gap that this thesis aims to bridge, the following research objective can be formulated:

Understand general patterns of different actors in dealing with food waste and identify the underlying institutions.

It is necessary to first understand the status quo of how food waste is managed in Cologne to then have a more detailed look at the underlying institutional networks.

1.4.2. Research Question and Sub-Questions

To be able to achieve the above-mentioned research objective, one main research question and six sub-questions have been formulated to guide the research process.

Main Research Question

How do Institutional Barriers and Drivers influence the Food Waste Management of Students and Food Waste Initiatives in Cologne?

Sub-Questions

The Sub-Questions have been formulated to eventually help answering the main research question.

1. How does the (organic) waste management system work in Germany?
2. What is the student's perception about food waste in Cologne and what do the students do to prevent food waste?
3. To what extent are the strategies, rules and norms of these actors in this area in line with each other?

1.5. Definitions

In order to be able to make a thorough analysis of the food waste issue in Cologne, some key concepts have to be defined to avoid confusion and to establish a common language throughout the research. The first key concept is the one of *food waste*. As having a clear and universal definition of food waste, which is also discussed later in the thesis, remains to be difficult, one definition is provided to establish a common ground for the later parts of the thesis.

1.5.1. Food Waste

According to the United Nations Environment Program, food waste "refers to food that completes the food supply chain up to a final product, of good quality and fit for consumption, but still doesn't get consumed because it is discarded, whether or not after it is left to spoil or expire. Food waste typically (but not exclusively) takes place at retail and consumption stages in the food supply chain" (UNEP, 2022). This thesis engages with food waste both at the consumption and retail stage. Therefore, this research considers food waste pure organic waste that is produced at an individual person's level. This does not include the packaging of the food.

1.5.2. Food Waste Initiatives

Another key concept of this thesis is the concept of food waste initiatives. The Cambridge Dictionary defines initiatives in general as "a new plan or process to achieve something or solve a problem (Cambridge Dictionary, 2022)." This thesis picks up on that definition and considers food waste initiatives as a collective term for different actors, who have as an aim the reduction of food waste. These actors include the initiatives Solidarity Farming, Food Sharing and the Food Bank Cologne.

1.6. Academic and Societal Relevance

Looking into the food waste behavior of German students in combination with the influence of companies, supermarkets and food waste initiatives is highly relevant. While studies on food waste behavior of German students are already scarce, research on the interplay of different actors and their role in constructing norms, rules and strategies are even more rare. Since food waste is a global issue, every perspective from any country on this topic helps better understanding the reasons and motivations behind food waste and helps improving the situation. This goes in line with Acheson (2020), who claims that more research needs to be done in other universities and other countries on the consumption and food waste behavior of students.

In this regard the role of companies and initiatives in combination with universities could lead to very interesting results as a facilitation of the interplay between these actors can lead to better results on food waste among students. Not only is the topic societally relevant, but also for the academic field, in particular the field of Industrial Ecology. Industrial Ecology is an interdisciplinary field that among other things aims to develop industrial processes that minimize material waste (El-Haggar,

2007). Since food waste and closing the food waste loop is one important part of the field of Industrial Ecology, this study will yield relevant and interesting insights into the relationship of the different actors, and how this relationship can be improved to improve sustainability. This can help developing new methods and tools for further research on this topic by providing a new angle through the combination of several actors instead of only looking at one in isolation.

Chapter 2: Background Information on Food Waste Management in Germany and Cologne

"How does the (organic) waste management system work in Germany?"

In order to be able to understand the food waste management system of Germany this chapter firstly, provides an overview about the most important actors that are engaging in reducing food waste in the bigger area of Cologne. Secondly, a political and legal perspective on food waste management is provided to showcase the current system. This is done, as this thesis seeks to give recommendations for other regions and countries for reducing food waste even more.

2.1. Actor Map

This actor map shows the interconnections of the most important actors that are engaging in food waste management. At the top there is the state government of North Rhine-Westphalia, which presides over the parliament. The government was recently elected and is constituted by the Green Party (Bündnis 90/ Die Grünen) and the Conservatives (Christlich Dmokratische Union). The opposition is composed of the Liberal Party (Freie Demokratische Partei), the Social Democrats (Sozialdemokratische Partei Deutschlands) and the right-wing Alternative for Germany (Alternative für Deutschland). In the Parliament, important decisions are being debated, which then go to a voting procedure, whether they are being transformed into regulations and laws and therefore are a crucial part of shaping norms and rules. Below the state parliament is the Food Council (Ernährungsrat) in Cologne, which is an association of experts and (former) politicians, whose aim is to lobby for a better policy on nutrition and agriculture. The food council is a connecting element between producers, politics and consumers, but also provides education about food to schools and kindergarten among other things.

In the center of the map are the companies *HelloFresh*, *Too Good to Go* and *Gorillas*. They are all subject to the rules and regulations of the state of North Rhine Westphalia. Hello Fresh is a company that was founded in 2011, which delivers food boxes to their customers at home. The idea is that customers select at home the desired food and Hello Fresh delivers the exact amount for each recipe and a manual how to cook the recipes. Through providing the exact amount of ingredients that are ordered through the website, the company claims that less food is wasted at the customers' homes.

The company Too Good to Go (TGTG) was founded in 2015 in Denmark and since then expanded to many other countries, including Germany. The companies' goal is the saving of as much food as possible from shops, such as supermarkets or bakeries, where the food is about to be thrown away. Customers can buy via the application of TGTG food baskets with random food items that are about to expire or where the best-before date has already passed. These food baskets are sold at a reduced price, since the food cannot be sold in normal retail anymore.

Gorillas is a very recently founded company that can be seen as an online supermarket, where people can order the food that they would like to eat, and it is delivered by the company within 10 to

15 minutes. The company also engages in reducing food waste through the on-demand nature of their business. The idea behind the concept is that people only order what they would like to eat at that moment and not much food has to be stored, which can go bad.

On the right-hand side are the Association Food Bank, Solidarity Farming and Food Sharing. The Food Bank is a very big association that operates all over Germany. Its aim is to get leftover food and food donations from supermarkets and private persons that is then further processed for people in need. The Food Bank has many counters where people, who do not have enough money to go to supermarkets, can come and have a very cheap or free meal. By selecting the food from the supermarkets that is leftover, or where the best-before date has already passed, the initiative helps reducing food waste considerably. Solidarity Farming is a concept that aims at participatory food production. The association of Solidarity farming encompasses several farms that are willing to stick to the goal of producing local, seasonal food for the consumers and integrate them into the whole production process. The consumers can subscribe to an abonnement with which they buy small and large food boxes for a monthly price and get once a week a delivery of seasonal vegetables and fruits.

On the center – left side are Rewe and Alnatura as two of the biggest supermarket chains in North Rhine-Westphalia and Cologne. While Rewe is one of the biggest chains in Germany, Alnatura is a smaller organic-supermarket franchise. They are a large donor for leftover food for the food bank, but also cooperate with Too Good to Go. These two supermarkets were selected for this research, due to their availability for being interviewed and providing information on their food waste management. However, there are many more supermarkets, which are not shown in this map, such as Aldi, or Edeka. On the left side of the two supermarkets is the University of Cologne, with its students, the University Canteen and the students that are going to the University canteen and the university. While the University is only involved secondary in food waste reduction through information distribution, the canteen on the other hand is a crucial part of the system, as here most of all food of the university is processed and eaten. Thus, the potential for saving food is much bigger. The government sets through laws and regulations the framework conditions in which the canteen and university can work and therefore influences the way in which they can contribute to reducing food waste.

Last, in the bottom of the diagram there is the Café Suedlicht, a small café in Cologne that has as an aim to reduce food waste. Next to distributing leftover food to staff, the café works together with Too Good to Go, by selling leftovers to them. Next to the café, Biogas Plants also play a crucial role in the treatment of food waste. While the Food Bank and Alnatura give food waste to Biogas Plants, these plants often also seem to be fed by fresh food that still would be edible. At the very bottom is the general garbage collection, the disposal of waste, which collects all waste that households, companies, initiatives and the industry throw away. Important to mention is that this diagram is a simplified overview about the actors that have been analyzed, or that are important in the area of food waste. More actors exist in retail or in gastronomy that are also engaging in reducing food waste, but due to the limited scope of this paper could not all have been taken into account for interviews.

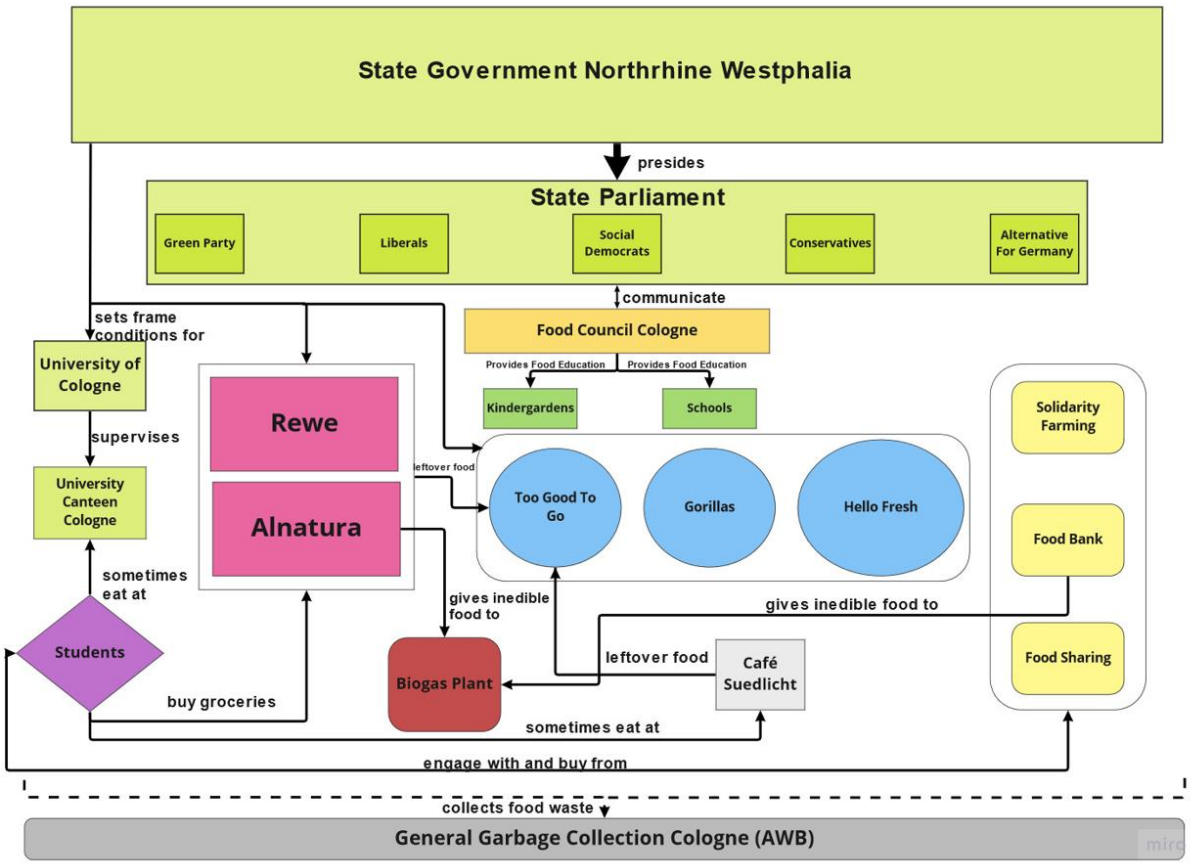

Figure 3: Actor Map Food System Cologne

2.2. Political and Legal Dimension in Germany and Cologne

"How does the (organic) waste management system work in Germany?"

Food Waste Management in Germany

In order to analyze the rules, regulations, norms and strategies of the different actors in Germany, the legal and political dimensions of the food waste management system should be introduced.

shows the current policy mix that is concerned with the food waste issue. Germany does not have a specific national plan on how to reduce (food) waste, but a national strategy, which was updated in 2020 (The "Waste prevention program of the federal government with the participation of the federal states"). Even though policies might be slightly different from region to region, the overall policy mix that addresses this issue consists of:

1. Market Based Instruments
2. Regulations and Regulatory Instruments
3. Technical Reports and Research
4. National/Regional Communication and Campaigns

5. Projects and Other Measures
6. Food Waste Included in other National Plans or Strategies
7. Reduction and Prevention Targets
8. Voluntary Agreements

While most of these instruments are available, implemented, or even already in force since a longer time, voluntary agreements and reduction and prevention targets have only recently come into play. While the *National Strategy for Food Waste Reduction* aims at halving per capita food waste by 2030, the *Too Good for The Bin* (“ Zu gut für die Tonne”) campaign tries to make consumers aware of food waste and therefore make them waste less. The campaign was launched by the Federal Government in the spring of 2012, as an information campaign against the disposal of food. The campaign includes a website with tips regarding food storage, food labelling, facts about food waste and recipes for leftover foods (Vowell, 2019).

Figure 4: Germany’s Policy Mix on Food Waste Management 2014 (derived from: Gheoldus, 2022)

Prevention of waste remains the most influential and important part of food waste, as Figure 5 shows, this part is given a lot of attention. Article 4 of the EU Waste Framework Directive (Directive 2008/98/EC) sets out this “waste hierarchy”, which has been transferred to German Law. However, the other stages, meaning the waste treatment, reuse and recovery remain a very difficult task, especially with food waste.

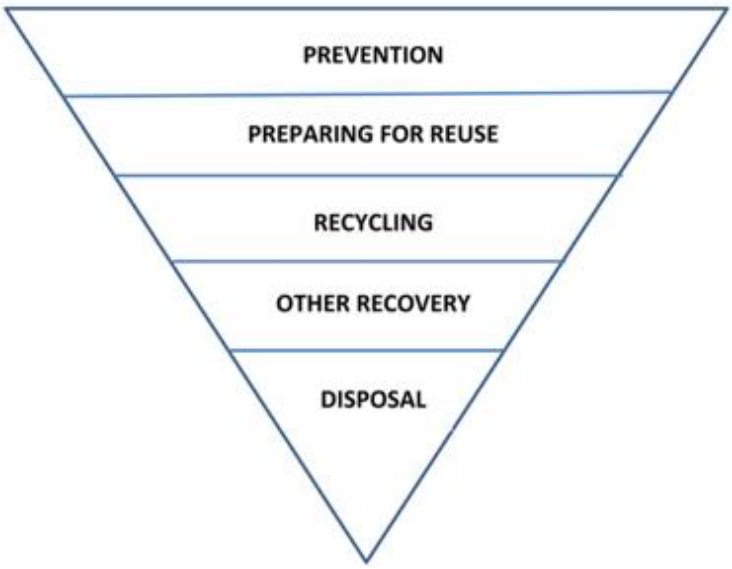

Figure 5: Waste Hierarchy according European and German Law (derived from: Nelles, Grünes, Morscheck (2016))

In Germany, the idea of a separate collection of organic waste from households was introduced in 1983 (Hermann, 2019) and made mandatory through the *Law on Closed Cycle Management* in 2015. Since 2005 wastes cannot longer be landfilled without pre-treatment (Nelles et al., 2016). In addition, there is a separation of *Green* and *Bio*-waste. While Bio or Organic waste encompasses food and kitchen waste, green waste includes garden and park waste that is brought by services to composting and recycling stations. Thus, food waste rather falls into the category of organic and bio waste that is collected at a household level in kerbside systems in bio-bins, or in a separate system for food waste from canteens, restaurants, and retailers. The waste that is collected in bio-bins will be either brought to composting, to anaerobic digestion plants, or is being combusted, as **Error! Reference source not found.** shows. Composting and anaerobic digestion can be done on a household level, while combustion has to be done under strict regulations. Composting organic waste and putting it into anaerobic digestion plants is the more favorable option to make use of the waste. While compost sometimes can be used as soil or fertilizer in gardens, anaerobic digestion turns the waste into biogas or fertilizer. This way much of the waste can be reused. However, as Morstadt and Striegel (2003) argue, the energy balance of the two options gives priority to biogas production over composting.

The disposal of waste as the least favorable option of the waste hierarchy consists of the collection and transportation of wastes, which are divided in two stages. Firstly, the collection of all household […] waste including the collection of recyclable waste as much as possible separately and secondly the transportation of the collected waste to processing and disposal facilities including the necessary transfers or intermediate storage (Umweltbundesamt, 2021). The process begins with the disposal of wastes into appropriate receptables and ends with them being emptied by collection vehicles.

Treating food waste and disposing it correctly is very important for environmental and climate protection. Schüch et al. (2016) claim that modern waste management saves annually around 56 million tons of carbon dioxide, which significantly contributes to the Climate Protection Goals that were set in the Paris 2015 agreement. **Error! Reference source not found.** shows the waste treatment options that are existing in Germany. Organic waste that is collected in the so-called bio-bins, is

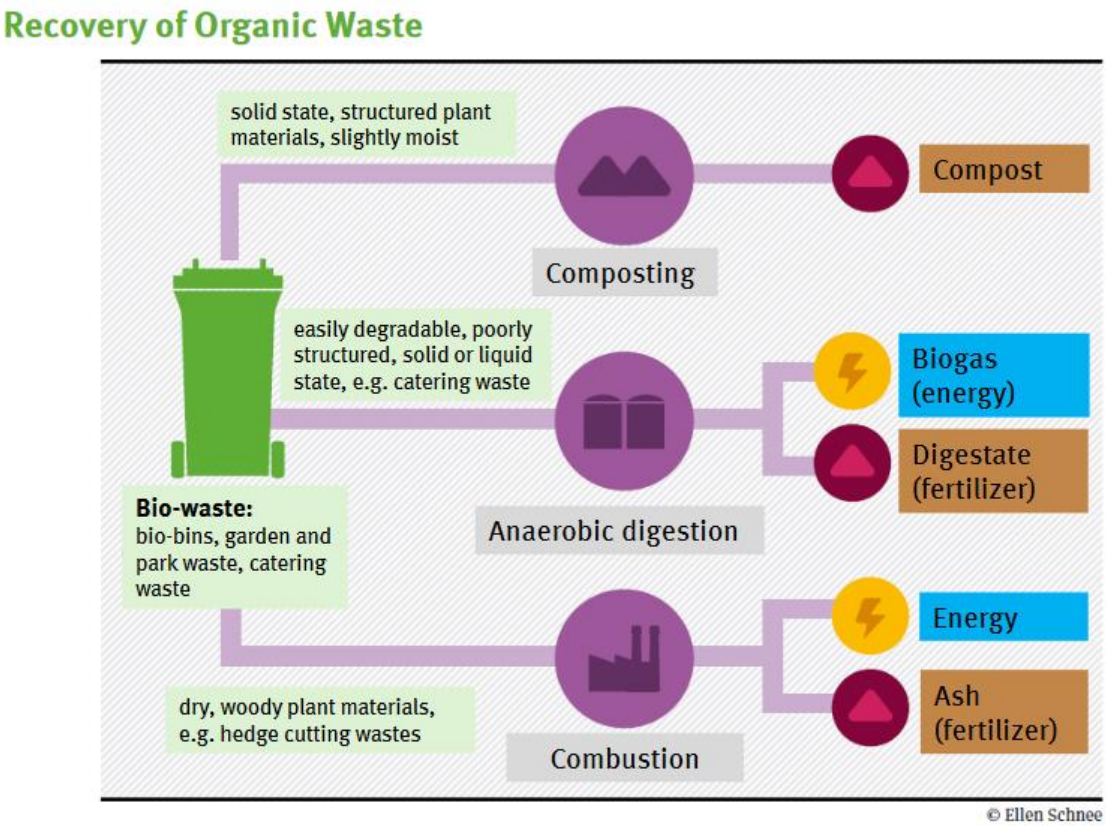

Figure 6: Waste Treatment options in Germany (Retrieved from: Hermann, 2019)

separated into categories

according to its state. While waste that still rather has a solid state and which is slightly moist goes into composting, dry and woody plant materials (hedge cutting waste) rather go to combustion, from which energy and fertilizer is made. Easily degradable, solid or liquid state waste is as a third option going into anaerobic digestion, from which fertilizer or biogas is made. Important to see is whether the options available are used effectively to close the cycle and make food waste more circular. As Gabriel et al. (2021) argue, food waste generally is on the agenda of the food retail sector in Germany, but up to now, voluntary actions were so far mainly used for image enhancement, as promoting waste prevention is accompanied with noticeable losses in sales (p. 965). Many supermarkets stimulate consumers to buy more goods by offering quantity discounts. Therefore, it is argued that more sustainable sales strategies are needed. Since this already happens at the retail stage of the food waste issue, attention also needs to be paid more to the disposal phase.

(Food) Waste management in North Rhine-Westphalia and Cologne

The section above has provided a small overview about the political, legal and operational (food) waste management landscape in Germany. As this thesis is concerned with Cologne, a more specific insight into regional and local efforts must be given. Since the introduction of the first Waste Disposal Act in Germany 1972, the main competences on how to handle food waste lie with the federal government. In Germany the Federal Circular Waste Management Act "is supplemented and

concretized by the waste laws of the states. However, due to the federal government's concurrent legislative competence for waste management, state legislation is only possible in those areas that are not already covered by federal law. The states' waste laws therefore essentially concern questions of enforcement […]" ("Abfallrecht", 2022). Therefore, the state of North Rhine Westphalia only possesses supplementary competences, which shows the necessity to provide an overview about the German federal regulations and strategies first, before giving insight into the local waste management strategies in Cologne.

The city of Cologne has also tried to engage in food waste reduction considerably in the past years via several events to raise awareness and bring the topic closer to the consumer. Moreover, a strategy workshop for a nutrition strategy for Cologne and areas around formulated goals for the further reduction of food waste in Cologne. Some of the strategies that were concluded are the facilitation of communication with actors that take leftover food, or to incentivize the general garbage Collection company AWB to increase fees for commercial food waste. Additionally, since February 15, 2022 Cologne is part of the Initiative "Städte gegen Food Waste" (Cities against Food Waste). The initiative was a joint effort of the city of Essen and the company Too Good to Go. Aim of the initiative is it to work on concrete measures to save food in restaurants, canteens, and other locations. Since the City Council has set as a main aim the avoidance of Food Surpluses, this initiative works as a catalyst. Next to this larger initiative, there were also smaller initiatives, such as "Sternekochen an Kölner Schulen" (Cooking at schools) and "Schad dröm" that should give children a greater conscience about the value of food. Not only children should be educated on food, according to the city of

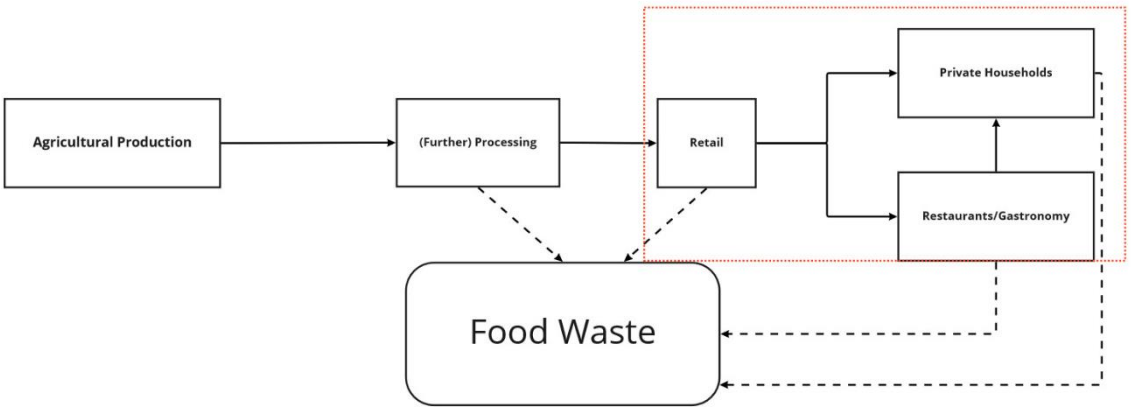

Figure 7: Areas of the Food Value Chain Considered (Based on graphic from Hafner et al., 2012)

Mologne, which is why the city in 2016 had a four-week program, called "Köln isst joot" (Cologne eats well), that offered different events to make people more conscious of food.

Food Supply Chain Explained

As this thesis not only looks at the food waste at consumption stage, but also at the retail stage, a small overview about the food supply chain is provided, to be able to better understand at what stage the food is wasted. Figure 7 shows a broad overview about the food supply chain, which more detailed in Figure 8. The red rectangle shows the areas of the food chain considered for this research. Figure 8 shows the food supply chain more detailed. First there is the primary production of the goods that are later sold in retail. After the harvest, where also a lot of the fruits and vegetables that are supposed to be sold later are already sorted out, the food is further processed and sorted according to standards and also the destination that it should go to. After this stage the food is going to the supermarkets, from where the consumers can then buy it. The retail and wholesale can also

redistribute leftover food, as it is shown in the diagram. For example, they can give the food to the food bank or food sharing. Consumers can be on the one hand private households, but also canteens, restaurants, cafés and so on. The food that is leaving this supply chain and which is discarded is called food waste. On the top, the diagram also shows non-food production chains, which include among other things biofuels, or biomaterials, that are made out of primary food production. Another stream that is shown is that freshly produced food is also used as Animal feed. The diagram shows that leakages are present at any stage of the food supply chain, which makes it even more important to save the food that enters the consumption stage. To sum up it can be said that in Cologne specifically, but also in Germany generally there are many actors that are involved in the whole system of food waste reduction. The topic sems to be present, as the food value chain from production to disposal has clear steps that are taken and some rules that flank the processes.

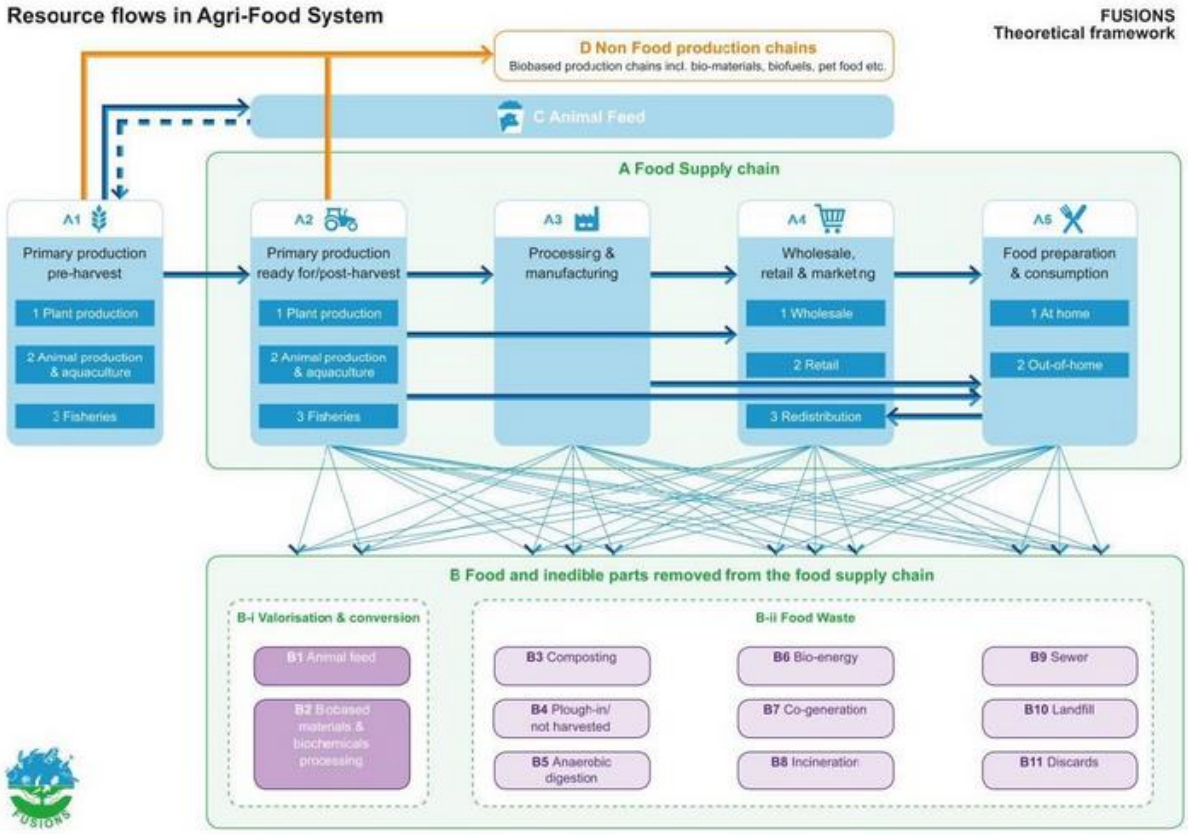

Figure 8: Resource Flows in Agri-Food Systems

Chapter 3: Methodology

3.1. Research Design

In order to answer the above reseearch questions, this thesis uses several methods for data collection and analysis. While for the data collection that is necessary to anaylse the norms, rules and strategies a survey, literature research and interviews are used, while the data analysis is done through an institutional network analysis. The Institutional Network Analysis including its Network-Diagrams, helps analyzing the social dilemmas (Crawford & Ostrom, 1995) that the institutions are facing and the different outcomes they have in

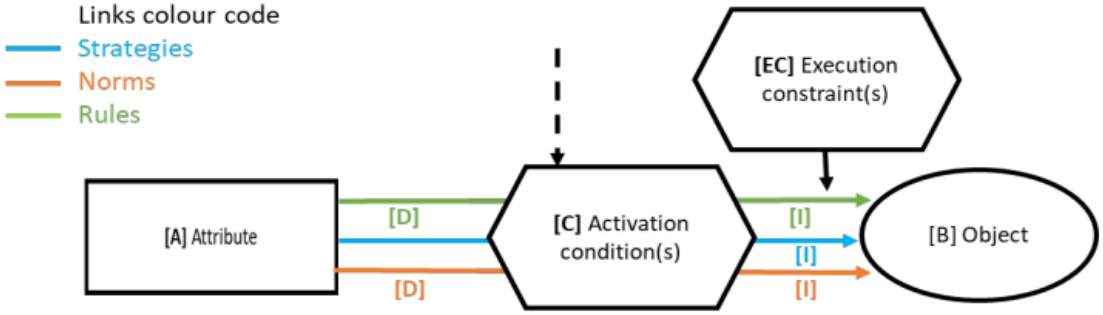

Figure 9: An Institutional Statement represented in Network Format (Ghorbani et al., 2021)

certain behavioral situations (Figure 9). Figure 11 is showing the legend of the institutional networks that have been created for this research. The institutional network analysis with its components is also explained more in detail later on. The thesis follows an interpretative research design which is simultaneously qualitative and inductive, as the student's food waste behavior is explored, by looking at different actors' rules, norms and strategies on reducing food waste. As this type of research has not yet been performed regarding food waste in Germany, or more specific Cologne, this research can be considered exploratory research.

3.2. Operationalization

In order to make the results measurable the Institutional Grammar (IG) is used as an analytical tool to create institutional network diagrams. Through the diagrams the rules, norms and strategies can be made visible and be analyzed. The Institutional Grammar is further explained in more detail in the following section. Additionally, for the more descriptive results, diagrams are used to visualize the findings and find general patterns that can give insights into the food waste management of the different actors in Cologne.

3.3. Institutional Network Analysis and Institutional Grammar

Having understood the specific mechanisms of food waste in Germany and specifically Cologne, as well as initiatives to combat it, this section now turns to the analysis of rules, norms and strategies by using the INA approach. This section is organized as follows: First, a small overview is provided about the action situations that have been found on food waste and a definition on rules, norms and strategies is provided. Secondly, an explanation of how the institutional network diagrams have been created is provided. Third, as this thesis makes a theoretical contribution to the Institutional Grammar by using a survey as data collection method and introducing animate objects and expectations to the diagrams, one abstract of this part is dedicated to explaining the theoretical suggestions.

Action Situations/Action Arenas

This thesis has identified several action situations, or action arenas in which rules, norms and strategies are formed. Before defining action situations, it is important to clarify what is meant by rules, norms and strategies. Rules are described by Ostrom (2005) as "set of instructions for creating an action situation in a particular environment (p. 17)". Rules can be written or unwritten and overall, they could be seen as binding agreements or strategies that have to be followed by actors. Norms on the other hand are described by Ostrom (2005) as "shared concepts of what must, must not, or may be appropriate actions or outcomes in particular types of situations" (p. 112). Important to add is that norms must be shared concepts about a certain behavior and the behavior must also be exercised by the different actors. A strategy which is defined in the context of game theory as "a complete plan of action a player will take given the set of circumstances that might arise […]", can be seen as the definition explains it (Hayes, 2022). As in institutional analyses often the term shared strategy is used, it can be said that a shared strategy is a shared plan of action by different actors to overcome a challenge.

Ostrom's Institutional Analysis and Development Framework that is used for the analysis on food waste in Germany, centers on these action situations (Sarr, Hayes, DeCaro, 2021). Ostrom explains that action arenas consist of two so-called holons, meaning participants and the action situation, that interact as they "are affected by exogenous variables and produce outcomes that in turn affect the participants and the action situation" (Ostrom, 2005, p. 13) An action situation on the other hand is defined by Ostrom as a social space, in which the participants with different interests interact, meaning exchanging goods and services, solving problems, or go into conflicts. For the topic of food waste five action situations were identified. These are *food waste prevention*, *food waste treatment*, *food waste disposal, sustainability understanding* and *best-before date*. For each action situation the relevant institutional statements have been selected.

Explaining the Action Situations of the Food Waste Network in Cologne **Error! Reference source not found.**

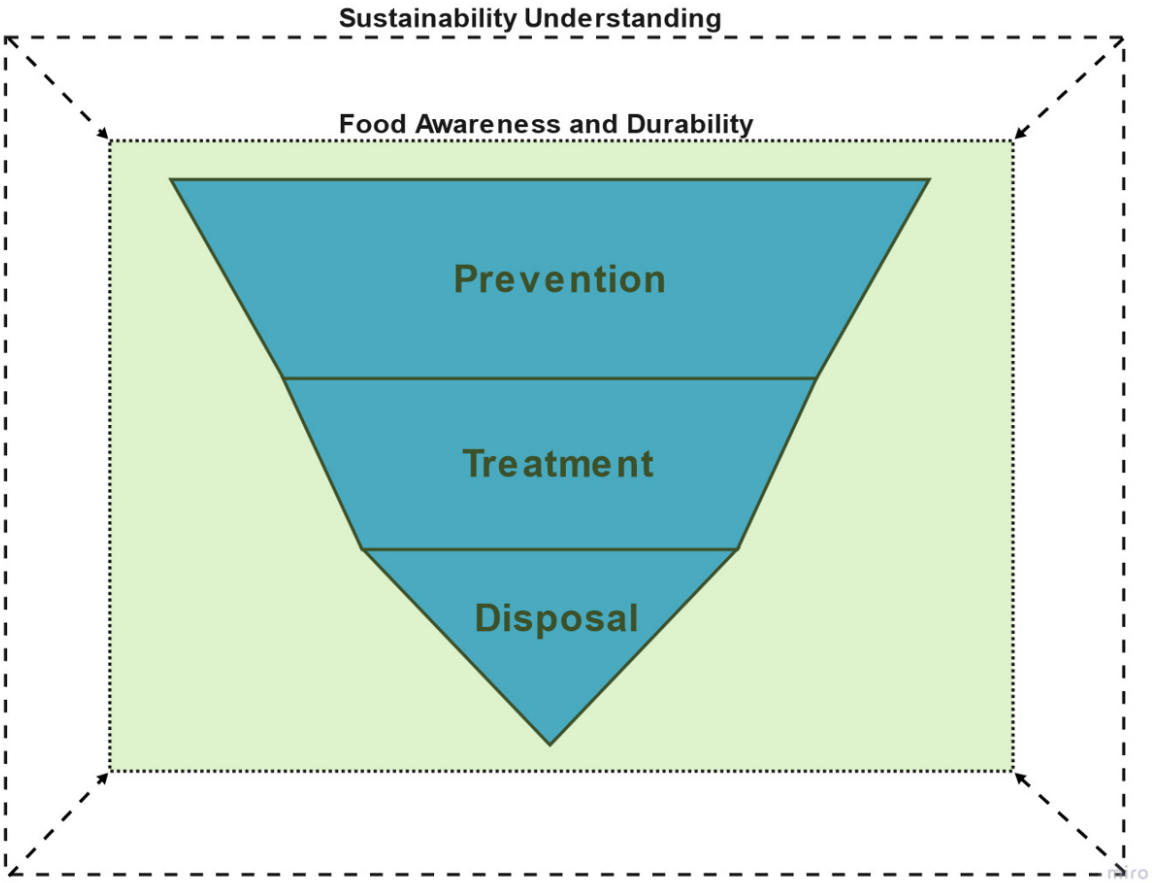

Figure 10: Understanding the Actions Situations of the Food Waste System in Cologne in Conjunction

Figure 10 shows the five action situations that have been introduced above. The figure can be considered onion-like, meaning that it should be looked at from the outside to the inside with different layers. Since the networks that are shown in Figures 27 to 31 should not be seen in isolation from each other, but in conjunction, this figure portrays how they should be looked at. Action situation *sustainability understanding* is the overarching frame, as the whole way how food waste is dealt with depends on the way people understand sustainability. People who might not be very much aware of sustainability issues, might also not be aware of food waste as an environmental and climate issue. This is the outer layer, which has indirect impact on the next layer the Food Awareness and Food Durability. This layer also includes the *Best-Before Date*, but most importantly includes the people's perceptions and way of dealing with food waste. Within this frame, a cone with the last three action situations, *waste prevention, waste treatment and waste disposal* are at the core. They represent the actual way how food waste is dealt with in Cologne, which is as shown above influenced by the peoples' understanding and perceptions of sustainability in general and food waste in specific.

Creation of and Assumptions for Institutional Networks

For the creation of the Institutional Networks according to Ostrom's method, all interview transcripts, the survey and the data from the desk research were coded in Microsoft Excel. The relevant tables therefore can be found in the Web drive folder. The interviews were coded with the ABDICO method (Meshdagi et al., 2021). During the coding process, institutional statements were extrapolated from the different documents and were categorized into the different action situations mentioned

above. The action situations were created on the one hand on the basis of Nelles, Grünes and Morscheck's (2016) waste hierarchy and according to the findings of the coding procedure. While the action situations *Waste Prevention, Waste Disposal* and *Waste Treatment* were used from the waste hierarchy pyramid, the action situations *Sustainability Understanding* and *Best-Before Date,* were created during the coding process. The coding showed that a general understanding of sustainability and discussions around the best-before date could be identified rather often, which is why these two were used as action situations. In all coding documents, the different statements were marked with a different color according to their action situation. Coding the Institutional statements from the interviews and the documents was rather straight forward, while coding the survey results needs some more clarification. As the number of survey participants was with 40 too low for being able to use the survey data statistically, the researcher created rules, to be able to code the survey results.

The survey results were firstly transferred into an excel document and different charts were created to give a good overview about the data. For the questions that were translated into pie-charts, always the answer option that was mentioned at least by 50% of the people was coded. If there was a second answer option that had at least 15% of the answers, the option was also included into the code. If there were no answers options with at least 50%, the options with the highest percentage were used to create the statement, which together made at least 50% of all answers. Through this it was assured that the statements that were coded from this were based on a majority of the answers of the students and thus could be considered a norm or a strategy. For the Bar Charts and the Hierarchy Charts the same method was used. After coding all documents, the institutional statements were transferred to the software Miro, a software for making diagrams among other things. For each action situation different frames were created, and, in each frame, all institutional statements of that action situation were created from the excel table. To continue, it is important to mention that the institutional statements that were extracted from the interviews and coded in the Excel sheet, were further pre-selected before visualizing them in Miro. Furthermore, after visualizing the statements in Miro, the final selection of statements was done to put the statements into a logical network. In each "selection" round, the statements that were not helpful, or that were similar to others were eliminated to avoid too large networks and confusing networks. Creating the networks was more difficult, as the statements needed to be connected in a logical way with each other.

After having created all the Institutional statements as graphical "arms", the composition of the Institutional Networks was done. For this the researcher followed the basic rules of Institutional Network creation, namely searching for conflict situations, where all elements of the institutional statement are the same, except either the Aim (I), or the Object (B). If such a conflict situation was recognized, it was marked with a star. Through these more complex connections and relationships, statements can be more easily visualized and provide the researcher with greater opportunities to visualize the Institutional Networks.

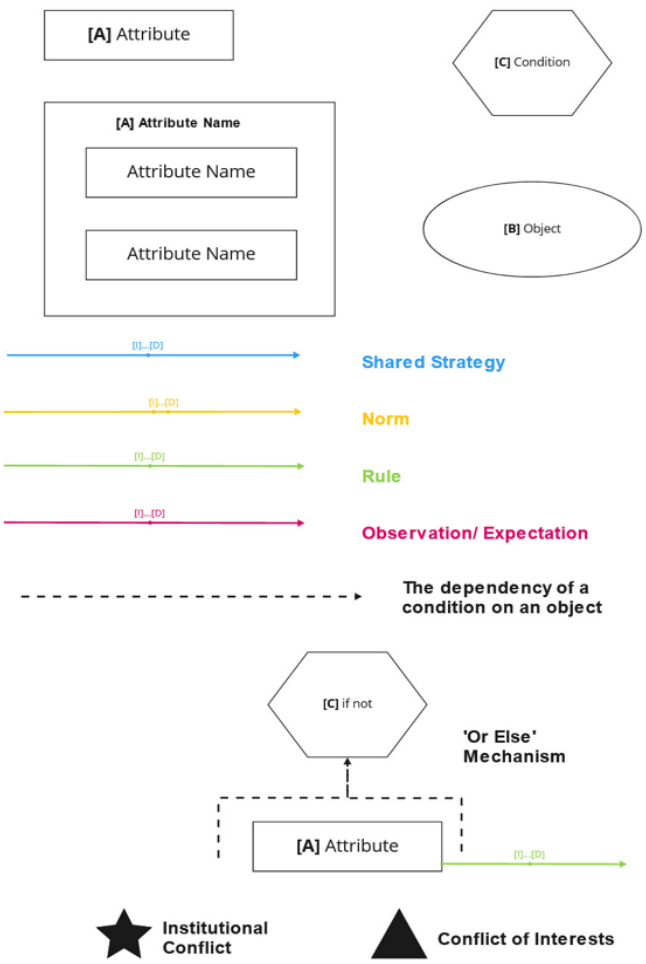

Figure 11: Legend of Institutional Networks

3.3.1. Theoretical Contribution to Institutional Grammar

The coding of the interviews and the surveys was done with the method of the institutional coding by Ostrom (2005). An institutional conflict is given, if the institutional statements are alike except for the Aim (I) or the Object (B). The institutional conflict is then marked with a star. This thesis makes a theoretical contribution to the Institutional Grammar in several ways. Firstly, for the first-time, survey results have been used for the creation of institutional networks. This can be seen as insofar relevant, as a bigger data basis increases the validity of the institutional networks and provides more elaborate insights into the student's food waste behavior. Using the survey data needs however clear rules on how to code the relevant information. These rules were described in the above section "Creation of Institutional Networks".

The second theoretical contribution of this thesis to the Institutional Grammar (IG) is the introduction of the animate object into the institutional networks. The animate object in contrast to the inanimate object is an object of one institutional arm, while being also the attribute of another institutional arm, combining the two arms with each other. Important to add is that animate objects are exclusively people or other "living" objects, while inanimate objects are "non-living" elements. Combining two institutional statements with each other can simplify the institutional networks by a lot and therefore make them more understandable. The animate object must however be used

cautiously by the researcher. Only institutional statements can be combined through the animate object, which build up upon each other. An example is provided in Figure 13.

The third theoretical contribution to the institutional networks is the introduction of a fourth "arm" that is marked by the color pink, named the 'observations' or 'expectations' arm. Observations and expectations are institutional statements that do not fall into one of the other categories (norms, strategies and rules), which are however a crucial part of the network. Since these many different expectations of different actors about other actors could be seen as contributing to the creation of values and norms, it is important to integrate these as a core part of the network. Important to mention is also that the expectations arm is somehow dependent on the norms, as without norms there would be no expectations. Expectations or Observations are either coded as norms, but in the diagrams not treated as them, or they are coded as an expectation. In the latter scenario the statement does not have a deontic [D] and the aim [I] needs to have the verb "expect" in it. Figure 14 and Figure 15 show an example of how the expectation and observation arm can be constructed. Being able to code them both ways, allows more flexibility regarding the type of statement that is coded. If it is important that the Attribute is the actor that has the expectation, the expectation statement should be coded without a deontic [D] and with the word "expect". If the actor behind the expectation is not crucial to the overall picture, then the expectation can be coded formally as a norm. Additionally, since in the case of food waste in Cologne there seem to be many opposing expectations, a new conflict situation is created for opposing expectations of different actors for each other. The different colors for the different arms are shown in Figure 12.

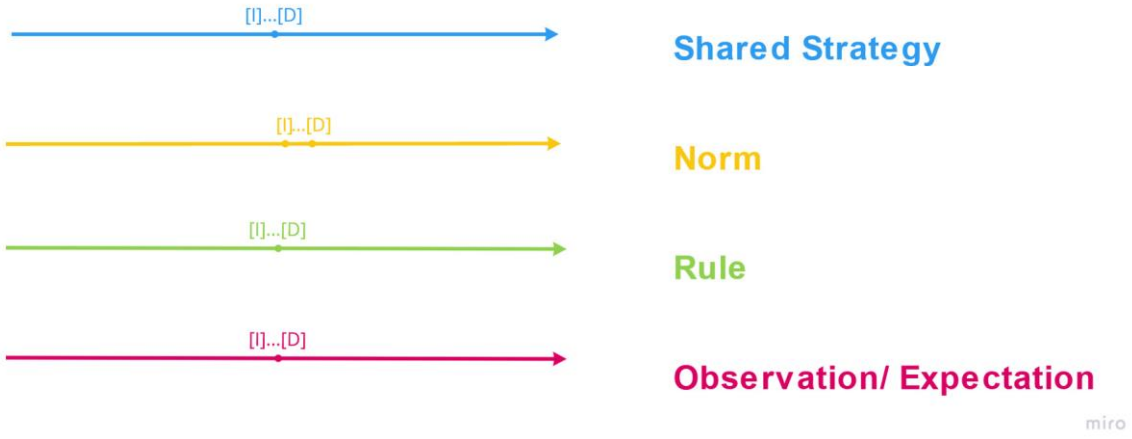

Figure 12: Colors of Different Institutional "Arms"

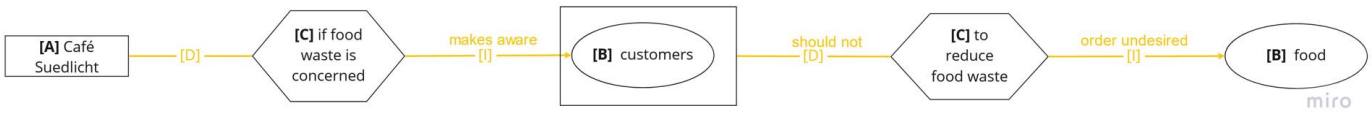

Figure 13: Example of an Animate Object

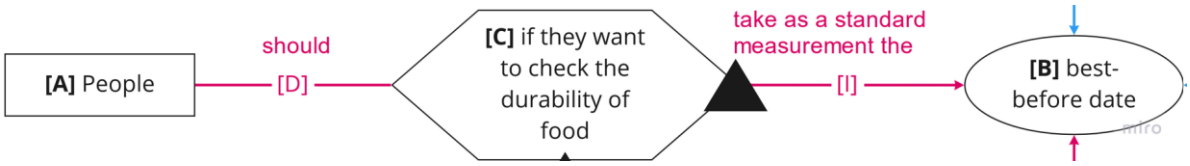

Figure 14: "Expectation/Observation" Statement coded Norm-Like

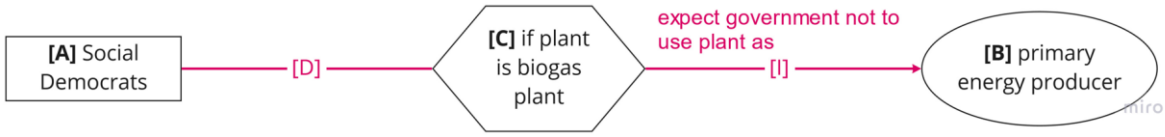

Figure 15: "Expectation/Observation" Statement coded with Aim [I] containing the verb expect

3.4. Data Collection Method and Data Requirements

To continue, a single case study of the University of Cologne is being conducted. A single case study has been selected to be able to make a more comprehensive institutional network analysis of one case. Additionally, since this thesis also takes into consideration the impact of municipal regulations and laws on institutions, a single case study is more within the scope of this research. The university that is selected for this study is the University of Cologne. It was selected because of its number of students and the existence of many actors that are concerned in some way with food waste. Since a threshold of a minimum number of 50.000 students was chosen to assure a larger sample group for the interviews, only student cities with at least this number of students were considered. Additionally, the University of Cologne has many different studies that allow selecting a more diverse sample for the food waste diaries and the survey. Only the Universities of Berlin and Cologne seemed to fulfill these conditions. The selection was done in favor of Cologne, as a multiple-case study would have been outside the scope of this research and Cologne offered a geographical proximity, which facilitates the research process, as interviews can be conducted more easily, and interview partners and students can be reached personally and not only via phone or Email. Although Cologne has been selected due to the above-mentioned factors, Berlin also would have been a very good sample for a case study. Furthermore, the city of Cologne is home to many companies and (food waste) initiatives that are somehow concerned with reducing food waste. As the thesis is concerned with the rules, norms and values of many different actors and how they can be aligned, this was also one of the most important selection criteria for this thesis.

To be able to answer the main research question and the sub questions of this research, data on the rules, norms and strategies of students and other actors that are involved in food waste management in Cologne is needed. To be able to get the necessary data, triangulation is used through literature research, a survey and semi-structured interviews. Having a diverse and broad data basis on the one hand increases the research's reliability and provides a better overview about the institutional landscape of food waste in Cologne.

First, semi-structured interviews are conducted with representatives of companies, initiatives and the university canteen to extrapolate the necessary rules, norms and strategies for the subsequent institutional network analysis. Semi- structured interviews in general have been selected as they "have a list of questions or fairly specific topics to be covered, […], but the interviewee has a great deal of leeway in how to reply" (Bryman, 2004, in Hofisi et al., 2014)". The interviews are therefore specific enough to get the information necessary from the interviewees, while also leaving enough room for additional input.

To continue, the reason why interviews are used in combination with an institutional network analysis are on the one hand side that interviews are very useful for studying behavior of a small group of people. Even though the interviews cannot be done in such a high quantity, they yield much better insights into the behavior of the students and therefore are much more valuable for the subsequent network analysis than other methods. Since interviews help with the "in-depth exploration of opinions" (p. 286, Halperin & Heath, 2017), they are used for finding out about the different actors' opinions on food waste in general and their attitudes towards food waste initiatives. The interviews are being conducted with representatives of the food waste initiatives and companies to be able to extrapolate the relevant institutional statements and perform an institutional network analysis according to Ostrom (1995).

Second, an anonymous survey has been designed for the students at the university of Cologne to get information on the one hand about their food waste behavior and on the other hand also being able to extrapolate the rules, norms and strategies on food waste that are necessary for the institutional network analysis. The survey consists of 35 open, scale and multiple-choice questions. Lastly, document research is the third data collection method, which helps collecting additional information on rules, norms and strategies by other actors, which could not have been interviewed and general background information on the food waste management system in Cologne or Germany.

3.5. Sampling Methods

3.5.1. Interviewee Selection

As this study is based on a lot of data coming from a survey and interviews, the sampling methods for the target populations must be clarified. The reason why interviews are used in combination with an institutional network analysis are on the one hand side that interviews are very useful for studying behavior of a small group of people. Even though the interviews cannot be done in such a high quantity, they yield much better insights into the behavior of the students and therefore are much more valuable for the subsequent network analysis than other methods. Since interviews help with the "in-depth exploration of opinions" (p. 286, Halperin & Heath, 2017), they are used for finding out about the students' opinions on food waste in general and their attitudes towards food waste initiatives. Firstly, the target population for this study are representatives of food waste initiatives, companies that also have the aim to reduce food waste and gastronomy. Secondly, the sample size needs to be defined according to Robinson (2014). Since the study is additionally conducting a survey, which can be rather seen as small interviews, the sample size for this thesis was set to 10 to 12 interviews in the beginning. Due to the limited availability and willingness of the participants to conduct the interviews, only 9 interviews were done in the end.

Third, the sampling method that was chosen to select the participants for the interviews is a purposive sampling strategy. According to Robinson (2014) the "rationale for employing a purposive strategy is that the researcher assumes, based on their a-priori theoretical understanding of the topic being studied that certain category of individuals may have a unique, different or important perspective on the phenomenon in question and their presence in the sample should be ensured" (p. 32). More concretely quota sampling, as one of the purposive sampling methods has been chosen to decide a quota for each of the actor categories, such as companies, initiatives, retail, and canteens. The quota was set to minimum one actor per category, without an upper limit. The sourcing sample, the selection of actors was done after researching them, to assure that they are able to provide information on food waste. As mentioned above nine actors were able to conduct the interview, while some actors did not accept the interview request. The actors were mostly contacted via email, or in rare cases by phone. The interviewees were informed about the reason and purpose of the interview and about what would be done with the interview data. If the interviewees agreed to participate, a

consent form was sent to them, with all important information the interviewees needed to know about the interview and how their data would be processed. Overall, the interviews are used to find out about the companies' positions towards food waste, their norms and strategies on how to reduce it. From the answers of the respondents one can then extract their institutions and see if there is (mis)alignment with the students' institutions.

3.5.2. Survey Respondents Selection

The sampling method that has been selected for the survey on the other hand, for which a minimum of 25 participants was set as the minimum number of participants, is a convenience sampling, since only through this it could be assured that enough participants would be willing to participate. Eventually, 40 participants were recruited for the survey, which can be seen as a good number for using the data in an institutional network analysis.

For the survey the author could fall back on snowball sampling through a small network of students at the university of Cologne. Additionally, students have been recruited by using social media channels, such as Facebook, or Instagram, for reaching out to bigger student groups. The respondent's targets age is between 18 and 26, which goes in line with Broshuis (2021), who also sets the average student age between 18 and 26 years. Since it is important to have an as diverse respondent group as possible that is between 18 and 26 years old, many different channels for selecting students have been used. For both samples, the interviewees and the survey respondents, the researcher acknowledges a selection bias, as not all respondents were selected completely subjectively. The selection bias is inasmuch not a big problem, as the study does only give small insights into the food waste behavior of some students and does not claim to representatively speak for all students.

Chapter 4: Results

"What is student's behavior on food waste and what are they doing to prevent food waste?"

In this part the results of the survey, the interviews and the desk research are brought together and are analyzed to eventually be able to formulate policy recommendations to be able to reduce food waste in Germany even further. The results chapter is twofold. While the results from the institutional analysis offer good insights into the norms, strategies and rules of the different actors, a more descriptive part analyses overarching patterns of misalignments that were observed in the interviews and the survey. The results are presented and contextualized right after they have been presented, to make the discussion and analysis more directly relatable to the results.

4.1. Descriptive Literature Results

Containerisation

Containerisation[1] is one of the main issues that was identified from the literature research. At the moment, containerisation is illegal in Germany, meaning that people who take food out of supermarket bins can be penalised for this (Barbutev, 2020). Even though there are food banks and other organizations that are trying to distribute leftover food from the supermarkets, there are still many supermarkets that throw away food. Some people therefore continue illegally taking out leftover food from the supermarket bins, due to various reasons.

[1] „Containern"is a German word for people taking out leftover food from supermarket bins. The word as such does not seem to exist in English and is translated in this thesis to containerization.

Pay-As-You-Throw (PAYT)

The system already exists in some countries, such as Canada, the US and Sweden, where it seems to work successfully. The PAYT approach is a weight-based approach, where consumers only pay what they throw away. As mentioned above, Cologne has a similar system, which might however benefit from some modifications. In Cologne, citizens can order waste bins from the local garbage collection AWB, for which they have to pay an annual fee ("Übersicht über die Gebührensätze in der Stadt Köln", 2022). Depending on the size of the bin, people pay more for a bigger bin and less for a smaller bin. The difference with the PAYT system is that in that system people pay a fee for their trash bags, and only pay for the trash that they produce.

Biogas Plants

While in 2014 around 8000 biogas plants were operational, in 2022 this number has only increased to around 9000 (Hummel, 2022). In 2014 it was estimated that around one to one and a half million tons of still edible food was used for generating gas in biogas plants (Eichhorn, 2014). Regardless of the small increase in numbers of biogas plants, the main issue with biogas plants seems to be the still high numbers of edible or processable food that is going into biogas plants for energy production, which indirectly contributes to food waste production.

Marketing Strategies by Supermarkets

To continue, Gabriel et al. (2021) found in their study that young people show more unique behaviour to food consumption, or food waste triggered, through marketing or sales strategies that increase their food disposal amounts. This could for example include special offers for a lower price or the large portioning of certain foods, which make especially younger people with less money buy these types of food, which has then higher chances of being thrown away.

4.2. Descriptive Interview Results – What is the Status Quo in Cologne?

The descriptive results part, which is presented in the following summarizes the most important findings from the interviews, the survey and the desk research that were not used for the institutional network analysis. As this thesis not only wants to investigate the institutional side of the food waste issue in Cologne, but also provide a general overview about the status quo of the students and other actors, this descriptive apart is also integrated into the research. Having a better overview about the food waste problem in Cologne eventually helps conducting the institutional analysis better. The First part of the descriptive results section in the following is dealing with different perceptions on food waste definition, to show the difficulty of clearly defining and measuring food waste.

4.2.1. Definition of Food Waste:

The question about the definition of food waste is an important one, even though not being part of the institutional network analysis as such. However, having an overview about some definitions of food waste gives good insights into the perceptions of food waste by students. This is important insofar as different perceptions on food waste can shape a (societal) discussion about the topic and also shows the status quo of the discussion.

Table 1: Definition of Food Waste by Different Actors

Actor	Definition of Food Waste
Solidarity Farming	Things that are edible but are thrown away and not used for as food. So the food waste, if at all, would happen within the family of the person who receives his or her Pot

Food Council	If there are no parameters and they all have to eat the large portions, then that is a waste of food for me. Food waste then starts when the farmer puts it on the tractor, packs it into the box and drives off with it and then resells it.
Green Party	For me, food waste is in principle a production that is not used as a human being or overproduction that is not used to feed humanity. So I would simply start with the fact that food waste starts with production, continues with transport and is ultimately a question of recycling.
Social Democrats	Food waste is food that is still edible from a green perspective and is perfectly okay, but which is then simply thrown away.
Food Sharing	I actually believe that a lot of food goes into the dumpster in Germany that is actually still edible.
Food Bank	Food is wasted when it can still be consumed.
Café Suedlicht	So food waste for me is when I don't value the food, i.e. the work that goes behind it.
Alnatura	In other words, a general food waste for me, or always in the sense of nature, is when good and well-preserved food is disposed of, which can definitely still be eaten. Even when it comes to exceeding, say with cool liquid products, they are often still edible, which are often disposed of because the best before date has been reached.
University Canteen	And when we talk about food waste, the word waste does mean that planning is not handled correctly.

As mentioned earlier it is very difficult to properly define and measure food waste. According to the EU Fusions programme, a research programme dedicated to find out about Food Waste in the European Union, food waste is considered "***Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed".*** (Gheoldus, 2022)

The UN environmental program in contrast defines food waste as "Food waste refers to food that completes the food supply chain up to a final product, of good quality and fit for consumption, but still doesn't get consumed because it is discarded, whether or not after it is left to spoil or expire". They also make an important distinction between food waste and food loss. Food loss according to them is "food that gets spilled, spoilt or otherwise lost, or incurs reduction of quality and value during its process in the food supply chain before it reaches its final product stage". Food loss occurs only before the food reaches the final consumer, while food waste mostly occurs at the consumption stage.

During the semi-structured interviews that were conducted in this thesis, one question was also about the definition of food waste. As it is very difficult for the individual consumer to know and estimate what food waste exactly is, it is important to show this difficulty and point to the fact that a

more concrete and easy way of measuring and defining food waste might be needed. For the solidarity farming food waste is “Things that are edible but are thrown away and not used for as food”. For the food council of Cologne, the large portioning of food in private, but also supermarkets is considered food waste. The local green party gave the definition of food waste as in “principle a production that is not used as a human being or overproduction that is not used to feed humanity”. Other parties interviewed saw food waste as food that is thrown away but that is still edible. Among these parties were the food sharing and the food bank in Cologne. One café staff member that was interviewed said that food waste has something to do with appreciation of the food and the work that was going into it before it can be bought.

Definition of food waste by students

In contrast to the actors the students as Figure 56 (Appendix B) shows, mostly defined food waste as “throwing away food that is still eatable”. The second most often used definition for food waste was “Buying more food than you need and throwing it away as it gets bad; eating out when you have enough food at home or food that has to be eaten and putting too much on the plate and then throwing it away”. This definition contains different actions, but in its core is about having or buying more food than one needs. The third most often used definition of food waste is “throwing away food, buying too much food to the point where its rotten because you can’t eat it up in time”. This definition goes into a similar direction as the one before but is not the same. The fourth most often used definition is “Throwing away food that is still eatable because they reached the best-before-date, or because you do not like them. The fifth most often used definition is “Food that is thrown away unnecessarily. Either because it would still be good, or because it was bought “too much” and has therefore spoiled in the meantime”. Sixth food waste is defined as “tossing out products that are still good or letting food in your fridge go bad because you rather eat out or order take away”. The last two least used definitions for food waste are “Not caring too much about food” and “Not eating it because of bad management”.

Even though the number of respondents is too small for interpreting the results statistically, the different definitions nonetheless provide a good overview about the difficulty of defining food waste in one overarching definition. Even though there are some common definitions of food waste, consensus is still lacking. Therefore, it is necessary to bring the topic more onto the political agenda and raise awareness, so a societal consensus on this topic and a definition can be found.

4.2.2. Actors’ perceptions of why students waste food

Table 2: Opinions on why Students waste food.

Stakeholder	Expectation of Why students waste food
Food Bank	With students. What I think I can only say from my personal point of view, of course. That is a lack of planning. Yes in purchasing and then in that. Um, I think they live a lot more spontaneous. So if something comes up today, in the evening when I actually wanted to cook something, then I'd rather go out with other fellow students and then it will just be what you actually wanted to cook.
Foodsharing	Probably the time in which this generation grew up, because we spent our youth with plastic packaging and fast food. At least this excessive

	consumption. I can quickly get anything from any corner, whether it's a coffee to go or a packaged dish or a pokeball that's in plastic packaging. I think it's such a habitual effect, i.e. that in your youth you found it normal that things are packed and that it just takes a few more years for something like this to click. And you think you could pack less things or throw them away.
Socialdemocrats	So I think you've just introduced that with this poor planning and then predictability, that they are not so structured in certain parts. I wouldn't think of much more spontaneously.
Café Suedlicht	This spontaneous lifestyle somehow results in food being wasted or someone lives in a shared flat, and has a shared refrigerator and that food somehow disappears in the back. And as a result, a lot of things are thrown away somehow, because it's not so present that you actually still have everything in the fridge.
Solidarity Farming	It's usually lack of experience and lack of planning.
Nutrition Council Cologne	So I say that students should go more often in unpackaged stores and you also have to raise awareness of this within the university. So I do it all myself as soon as I buy things in packaging. All the packaging waste and there are lots of things that then also spoil. And when I think about unpackaged food, I can fill them myself, I can weigh them myself. I get a completely different relationship for that.
Green Party	Lack of education and a lack of sense of responsibility, which in turn has to do with education and volume.
Alnatura	Students waste food because of lack of experience on how to handle food and because they go home often and forget food in the fridge.
University Canteen Cologne	No Answer.

The analysis of the expectations of different actors about why students waste food in the first-place show that many people expect students to waste food because of bad planning and a more spontaneous lifestyle. The second most often mentioned reason was a lack of education and experience. One interviewee said that it is a generational thing that the current younger generation is growing up in a society where everything is available at any time and people just lose the relation to the food they eat. The results of the student survey show that the students are mostly throwing away

food because it was mouldy and not eatable anymore. This could indicate that food often runs bad. Some of these difficulties in prevention food waste were also mentioned by the students. The three most often-mentioned reasons were the changes of plans in their daily lives, cooing too much and that some food goes bad very quickly. Comparing the expectations of the stakeholders with the data obtained by the students, no big misalignments can be found. The most often used difficulty for the students, namely spontaneous changes of the daily life, was also the most used reason among the stakeholders' expectations. This clearly shows the need for more food sharing and on-demand food offers, especially for students, which can help reducing the amount of food that has to be stored at home. Important for this would be that food sharing offers and on-demand offers have to be made economically viable for both students and the services.

While the definition of food waste shows misalignments between the actors in Cologne, the perceptions of the different actors on why students waste food are more aligned with each other. The misalignment of the perception of what is food waste indicates that no societal norms and a common understanding of food waste has yet developed in Cologne. There seems to be a general awareness of the issue but not to the extent to which it would lead to a broad consensus on how to deal with the issue. Therefore, political interventions as much as educational measures are needed to create a common understanding and awareness about food waste.

4.3. Descriptive Survey Results

As another part of the general observations, some of the survey results are presented in the following. The number of participants is with 40 comparably low, which is why the survey results are mostly used for the subsequent Institutional Network Analysis and this descriptive part. Important to mention is that this thesis mostly refers to the "expiration date" of food items, as this is the most direct translation of the word "Mindeshaltbarkeitsdatum" in German. The Best-before date, as it exists in Great Britain for instance is not being used in Germany. The most important survey results are being described and eventually evaluated and discussed, to provide an overview about the student's food waste behavior. More results and graphics from the survey can be found in Annex B.

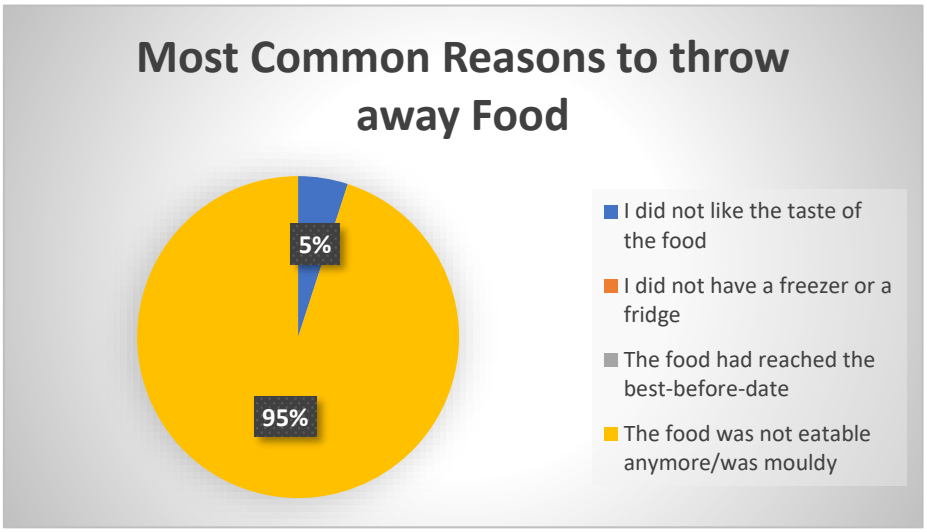

Figure 16: Most Common Reason to throw away food

Regarding the most common reason to throw away food a great majority of the students selected the option that the food was not eatable or moldy. Interesting to see is that no one of the respondents selected the option to not have a freezer, or that the best-before date has been reached. This could also have to do with the fact that if the food is already moldy, it probably has reached its

best-before date. Therefore, it would have been better to make this question an open question, to allow for more diverse answers, or to provide the respondents with a greater diversity of answer possibilities to also be able to reflect these in the institutional analysis.

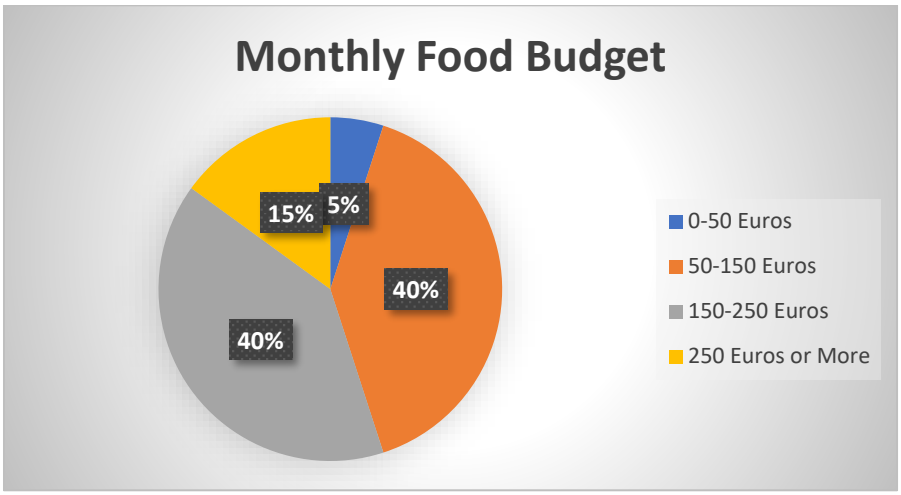

Figure 17: Monthly Food Budget

The tendency of the food budget available to the respondents per month that was reported was either between 50-150 euros per month or 150-250 euros per month, with around 40% of the respondents each. Only 5% of the respondents had a between 0 and 50 euros per month for food, while 15% of the respondents had 250 euros or more for buying groceries per month. Even though the number of respondents was too small to take these values as full statistical values, but the majority of the respondents has a food budget of 50-250 euros per month. Not having enough money could help on the one hand side to reduce food waste, as the economical aspect of throwing away food becomes very important to students, while it also can be a barrier for food waste reduction, as people with less money might have to rely on offers in the supermarkets, which often are quantity wise a lot of food, which might then be stored and gets bad.

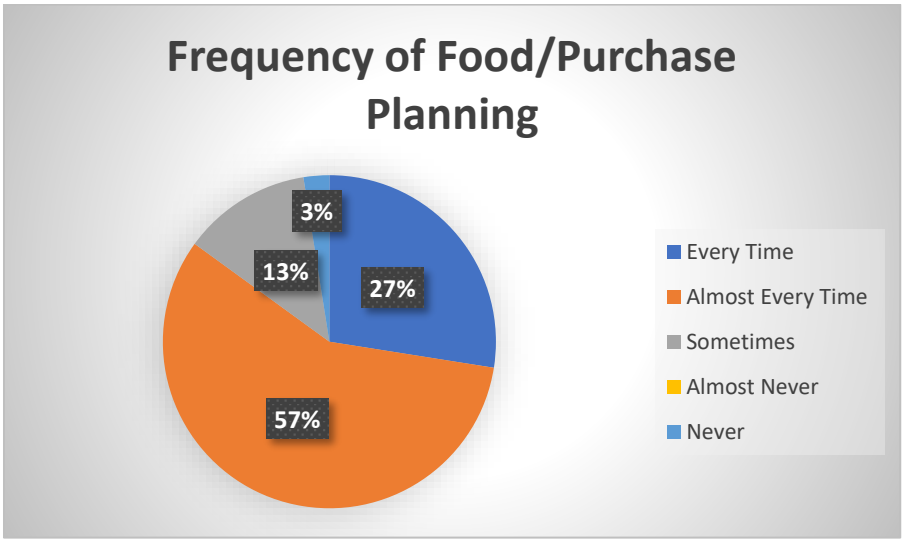

Figure 18: Frequency of Food/ Purchase Planning

Asking for the frequency of food purchase planning gives good insights into the planning behavior of students. As it is visible the great majority of the respondents answered that they were

every time or almost every time planning their food purchase. Only a smaller minority only sometimes or never does it. Thus, this shows most students have a clear strategy of planning their food purchase.

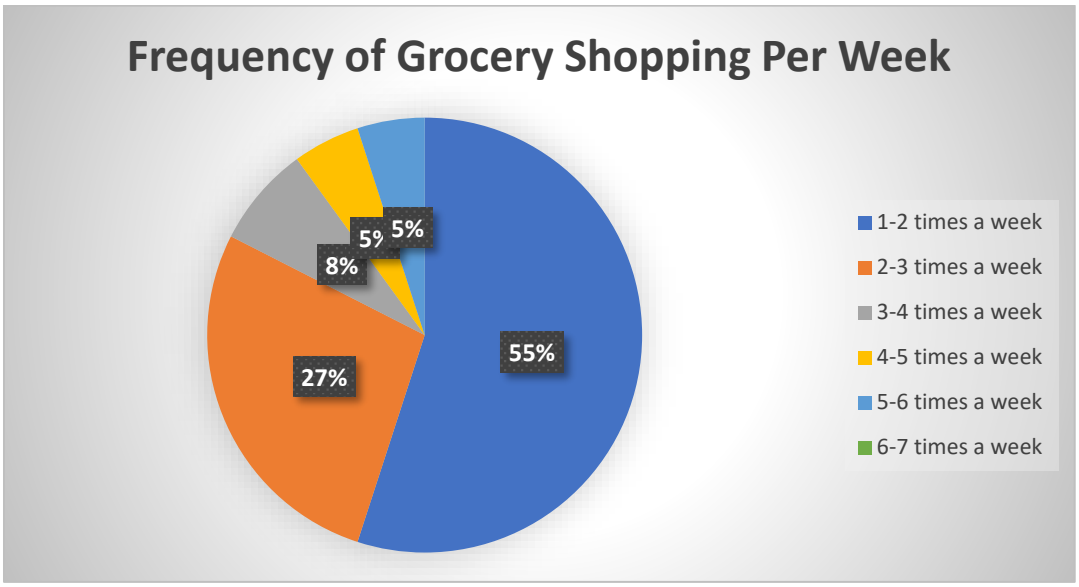

Figure 19: Frequency of Grocery shopping per week

The category frequency of grocery shopping per week is interesting to look at because the more often people go to the supermarket, the less they normally buy and the less they have to store. People living closer to a supermarket can go grocery shopping more often and therefore can buy less each time. Therefore, less food has to be stored that can go bad, as people can buy food more on demand. The vast majority of the respondents goes grocery shopping one to three times a week, while less than a quarter of the respondents goes grocery shopping three to six times a week. The reasons for the students behavior to go grocery shopping in this frequency remain unknown, it is nonetheless interesting to see that the majority goes grocery shopping less often.

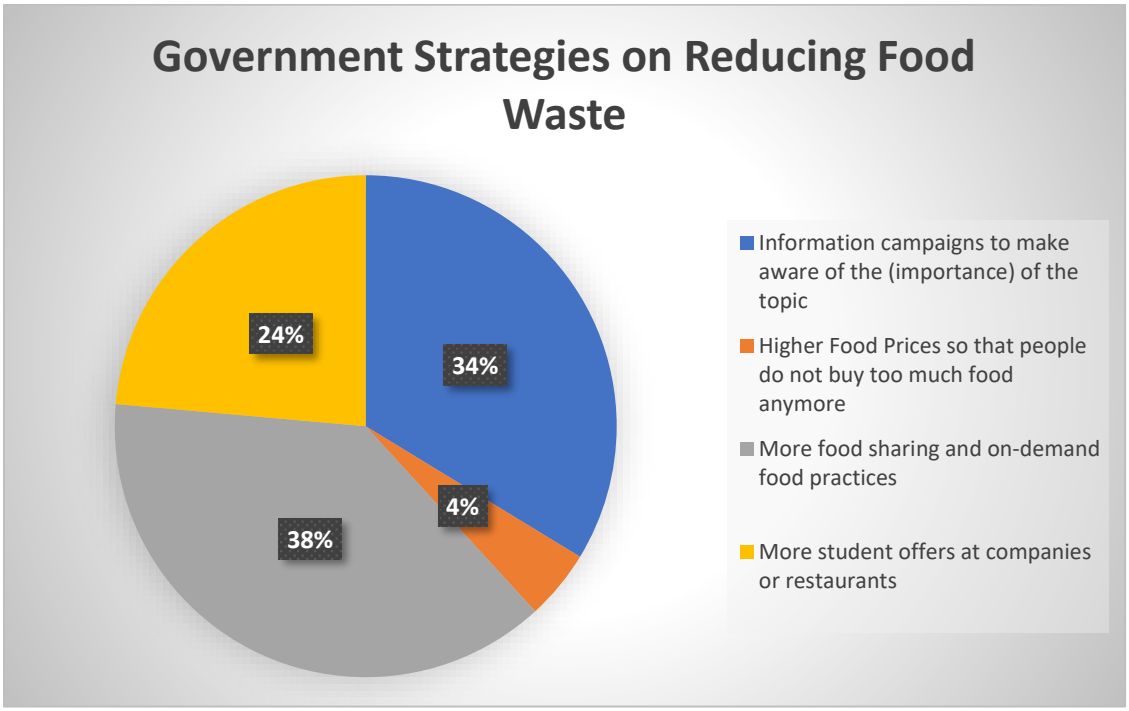

Figure 20: Government Strategies on Reducing Food Waste

Regarding the question of what the students would consider the best governmental strategy to reduce food waste, it is interesting to see creating more food sharing offers and creating more awareness are roughly voted for to a similar extent. More student offers at companies and restaurants were the third most often given answer. Providing more student offers at restaurants, canteens or companies, such as Too Good to Go, might lead to the fact that also students are able to eat more often outside the house and do not have to care for their own food that much anymore. This would mean that students would not have to store that much food anymore, as due to their more spontaneous lifestyle they would then be able to eat more often at the canteen or order food with too good to go. This question shows however that among students there is no clear norm or expectations on what could be done better by the government. There are tendencies towards information campaigns and more food sharing services, but a clear norm cannot be derived from this.

Figure 21: Engagement with Food Waste Initiatives

The engagement with food waste initiatives seems to be rather low among the students. Almost three quarters of the respondents say that they are never or almost never engaging with food waste initiatives. For this question a clarification of the term engagement would have been helpful to see how many of the respondents are actually working for food waste initiatives and how many are "only" getting food from food sharing, solidarity farming, or the food bank. The discrepancy between the expectations of students on what strategies the government should follow to reduce food waste and what they are doing themselves is definitely given. This, however, will be elaborated more in the institutional network analysis part.

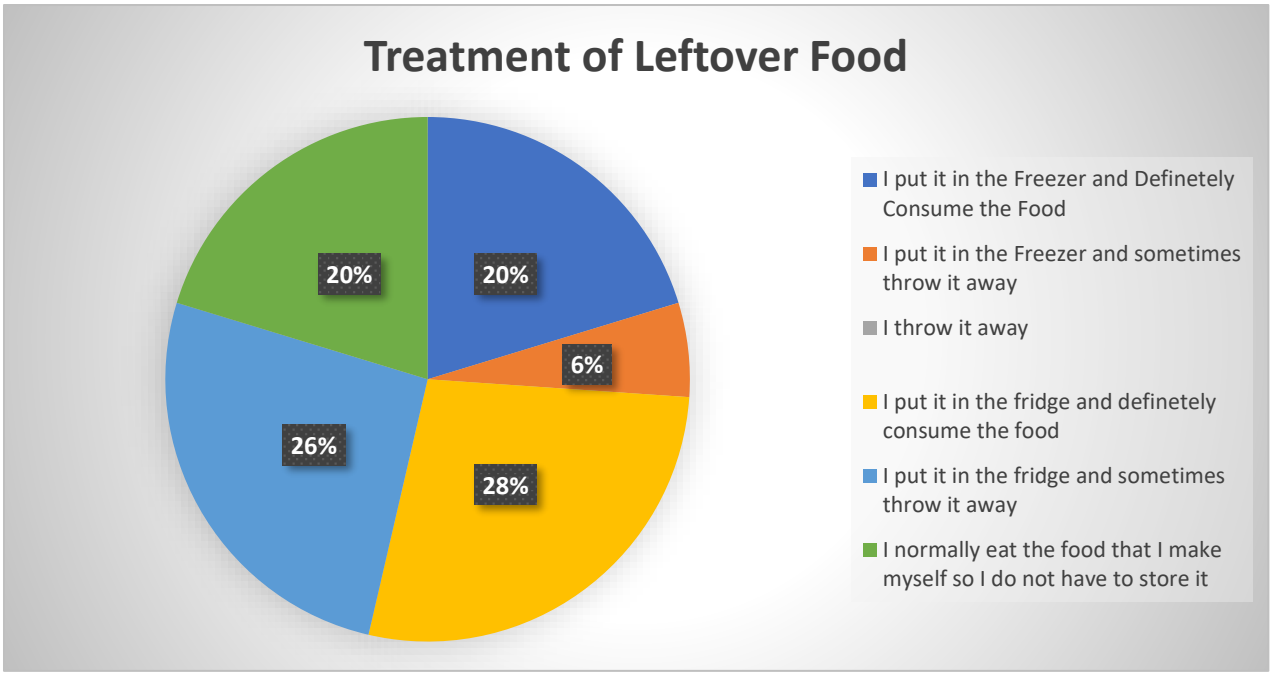

Figure 22: Treatment of Leftover Food

Regarding the treatment of leftover food, the strategies of the students are quite balanced. None of the respondents just threw away the food without storing it. Most of the people put their leftovers in the fridge and freezer and consume the food, while almost half of the respondents said that they put the food in the fridge or freezer and sometimes throw it away. These results show that the respondents are not having a clear strategy on their leftover treatment, but that it often differs what they do with the food. Interesting at this point would be to know why the students that are storing the food in the freezer are throwing it away sometimes.

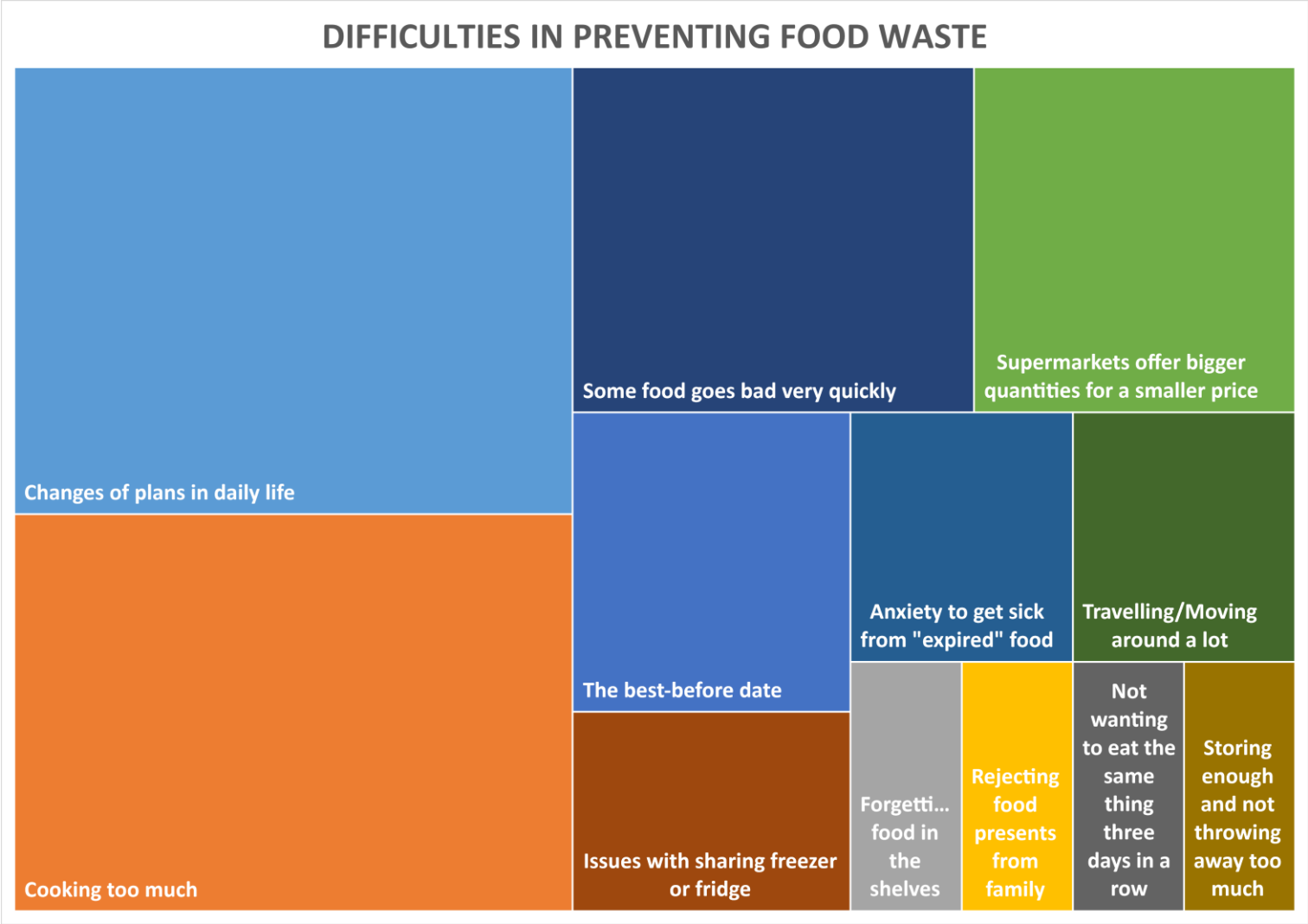

Figure 23: Difficulties in Preventing Food Waste

The category difficulties in preventing food waste should show the hurdles and problems that students are facing during the food waste reduction process. Providing an overview about the difficulties and strategies that students have in preventing food waste helps understanding their strategies and behavior a bit more and helps eventually formulating policy recommendations to prevent food waste. The largest part of the respondents claimed that changes of plans in the daily life are a big issue for reducing food waste effectively. This coincides a lot with the expectations of the other actors, why students waste food. The second most often used reason was the portioning of food that students often were cooking too much and then the food ran bad. The third most often claimed difficulty with reducing food waste is that some food items go bad more quickly than others and that the students cannot handle this always. The fourth most often used reason was that supermarkets often offer bigger quantities for smaller prices, so that buying more becomes often more rentable than buying less. The fifth most often claimed difficulty was the best-before date, namely uncertainties about what it means and how long after food is still eatable. Other reasons or difficulties that were encountered but less often are “Issues with sharing the freezer or the fridge”, “anxieties or insecurities to get sick from expired food”, “travelling or moving around a lot”, “forgetting food in the shelves”, “rejecting food presents from the family”, “not wanting to eat the same thing three days in a row”, “keeping a good balance between storing enough and not throwing away too much”.

Figure 24: Who should be Responsible for Food Waste?

The question about responsibilities for reducing food waste should give an overview about the expectations of the students for whom should take care of reducing food waste. Comparing these expectations with the ones from other actors can give an indication about the willingness to act for the different actors. For the category who should be responsible for food waste, five bigger categories could be identified from the respondents' answers. The two most often given answers are first that producers, companies and supermarkets should be equally responsible for reducing food waste and second that a shared responsibility among all societal actors should be the aim instead of giving one part more responsibility. The second most recurrent answers are that the consumers themselves should be responsible, while the other answer rather sees the responsibility with the government or politics in general to reduce food waste. The smallest part of the participants saw a main responsibility with restaurants. These answers are quite similar to the ones from the interviewed actors, of which also a bigger part saw a shared responsibility between many actors or also the government. However, seeing a greater responsibility for themselves was not part of the answers.

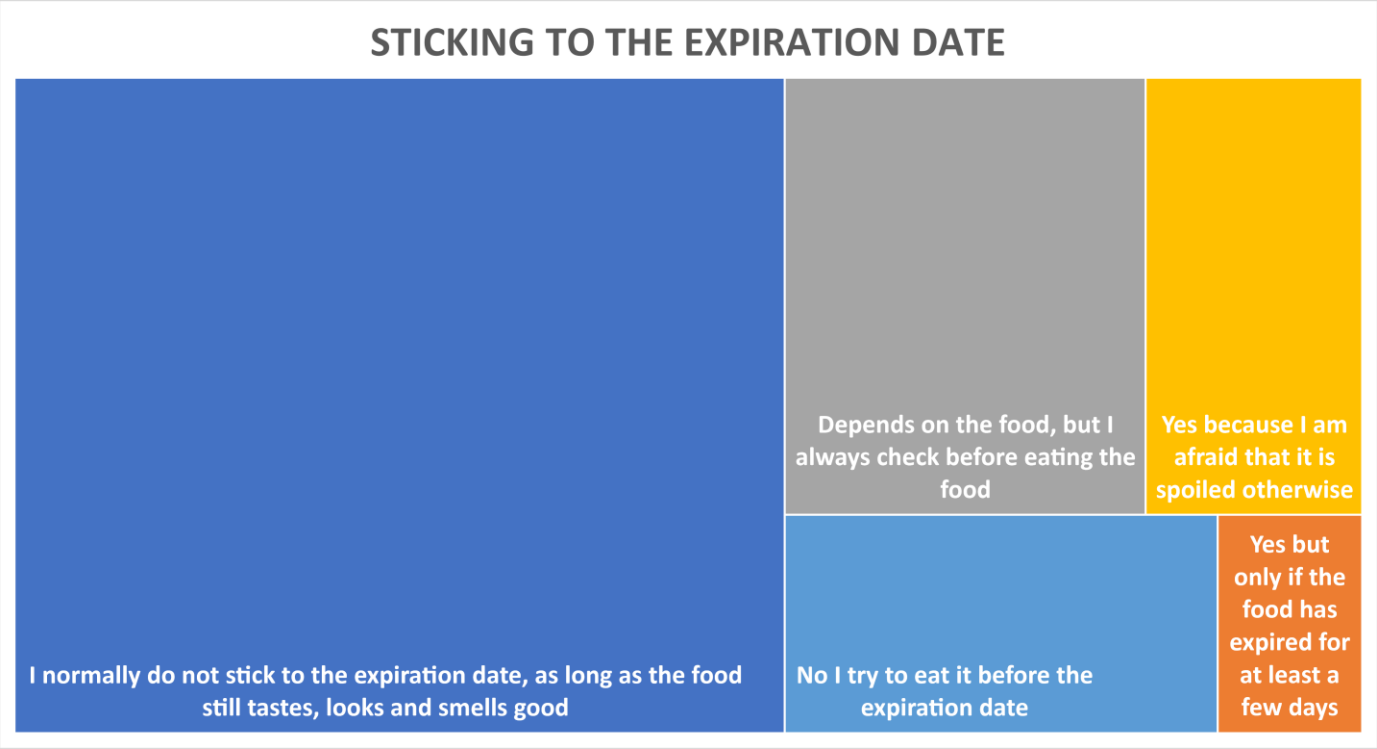

Figure 25: Sticking to Expiration Date

For the question if the respondents normally stick to the expiration date of food items, a big part of the respondents answered that they normally do not stick to the expiration date, as long as the food still tastes, looks or smells good. Respondents also stated rather often that sticking to the expiration date of food would depend on the type of food and that the respondents would always check the food before eating, while another larger number of respondents said that they normally eat the food before the expiration date. The answers with the smallest number of respondents were that some respondents stick to the expiration date, because they were afraid that it otherwise would get spoiled, while another few respondents answered that they would be only sticking to the expiration date, if the food has expired for at least a few days. The last answer does not immediately refer to the expiration date as such, but to the edibility of the food after the expiration date. The answers show that there is no general consent on the use of the expiration, or best-before date, but rather different opinions about it.

Figure 26: How to Prevent Food Waste

For the last open question of the survey on how the students were preventing food waste in their daily lives, five overarching answers were identified. The most often given answer was that the students were buying more consciously, only buying what they had planned to buy and going grocery shopping more often to have to store less. The second most often given answers were that the students were sharing food more often with others and trying to reuse leftovers and making food more durable by paying more attention to putting leftover food in the fridge or freezer. The second least given answer was that the students were checking the expiration date of food more often, so less food expires and must be thrown away. The least often given answer was that the students were buying less fresh food that could get bad quicker. Looking at the answers overall, a bigger majority of the respondents tries to be more planned and conscious with food, sharing food more often or paying attention to making food more durable. Paying special attention to the expiration date, seemed to be less of a solution for the respondents. This could make one think about the role, or even the importance of the expiration date, if not that many students are trying to reduce waste by paying more attention to the expiration date. Therefore, it should be discussed, if the framing of expiration date continues to make sense, or if another or even hybrid solution with a combination of expiration date and best-before date.

4.4. Institutional Network Results

"To what extent are the strategies and behaviors of these actors in this area in line with each other?"

The section above has provided a good starting point for this section, which is dealing with the institutional networks of actors in Cologne. The following section is therefore having a close look at the institutional networks that have been created, by showing and discussing the rules, norms, strategies, and expectations that were found. Especially expectations are, as the following analysis shows, a crucial element of the networks. As mentioned above this thesis considers expectations as

new elements in the networks. The following sections therefore is divided into the four categories, rules, norms, strategies and expectations, to allow close-up looks at the different elements of the networks. Figure 27, Figure 28, Figure 29, Figure 30 and Figure 31 show the created networks for each action that has been defined earlier, namely *Waste Prevention, Waste Disposal, Waste Treatment, Sustainability Understanding* and *Best-Before Date*.

4.4.1. Rules

To start with, the institutional networks are to a very large degree composed of expectations, while rules, norms and strategies are represented in different and smaller shares in the action situations. What becomes visible is that only the action situation *waste treatment* displays some rules. The rules in the action situation concern mostly rules for businesses or initiatives, which food they are allowed to sell. These can be partly rules that are set by law through the government, but also rules of initiatives which are unofficial rules that the initiative or the company set themselves. For example, the food bank has as a rule that they have to provide leftover food from supermarkets or other sources for a lower price to people in need. Thus, only in the food waste treatment phase there are some formal and informal rules.

4.4.2. Norms

As mentioned above, the institutional networks for food waste management in Cologne show that norms are barely existing. While in the stages of *waste prevention* and *waste treatment* a few normative statements could be found, in any of the action situations norms are not present. In the action situation waste prevention one institutional misalignment was found. While it seems to be a norm that supermarkets and businesses should not only for convenience throw away expired food, but they also nonetheless often do so in reality. For some supermarkets it is easier and less time consuming to just throw leftover food away than collect it and distribute it to food waste initiatives. This conflict needs to be resolved so that not that much food is anymore thrown away in retail. In the action situation *food waste treatment,* opposing norms were found, namely that supermarkets should not be forced to distribute expired food.

4.4.3. Strategies

To continue, zooming a bit out and looking at the action situations from afar, one can see that shared strategies are a bigger part of the institutional networks. Especially at the stage of *waste disposal* solely shared strategies could be found. While for the other action situations strategies are a part of the network systems, for the stage of waste disposal there do seemingly only exist shared strategies. Interesting to see is that the few animate objects that were identified, always include a shared strategy by an actor. Since animate objects can show connections of different actors, but also connections of norms, rules, strategies or expectations with each other, it is interesting that the ones that were identified always include a shared strategy. For example, in the *waste treatment* action situation, there is one animate object, which is misaligned with other objects. While there is an expectation for businesses to not use biogas plants for their food waste, as often fresh food is thrown into the biogas plants as well, Hello Fresh is using biogas plants. Thus, an expectation is not fulfilled by some actors, which is a misalignment that needs to be resolved. Furthermore, two other observations are worth mentioning. While the data shows that a clear definition of food waste does not exists in the peoples' minds, food waste also more often seems to be mixed up with being sustainable when buying food. Therefore, the action situation *sustainability understanding* was created, which reflects that many people more often think about buying organic and sustainable groceries and still do not have that much yet the food waste aspect in their minds.

4.4.4. Expectations

The most important finding of the institutional network analysis is the many opposing expectations by the different actors in the network system. Expectations, as it has been explained above, have been identified for the first time in an institutional network analysis. Looking at the five different action situations, it can be clearly said that expectations are an elementary part of the institutional food waste network in Cologne. Not only are there many different expectations by the different actors regarding what should be done to reduce food waste in Cologne even more, but a few misalignments among expectations were identified. For example, in the action situation *Best-Before Date*, two directly opposing expectations were identified. On the one hand people are expected, to check the best-before date, if they want to find out about the durability of food, whereas another expectation claims that people should not take the best-before date as a sole indicator. Another misalignment of expectations that were identified, can be found in the *Food Waste Prevention* action situation. The government is expected both, to introduce and not to introduce a legal basis for the compulsory distribution of expired food. Again, this misalignment of expectations reveals that despite all efforts that are done and a general awareness on food waste, the topic still needs a clearer structuring and framing by the government through clear guidelines and regulations. These conflicts are especially interesting to look at, as expectations can lead to establishment of norms, which are shaping human behaviors.

To continue, one other interesting finding in the area of expectations is that on the one hand students expect the government to support the creation of more food sharing and food waste initiatives as such, while on the other hand barely engaging in food sharing offers or other initiatives themselves. This contradiction well summarizes the opposing expectations by many actors that many people and companies would like to do more, but do not feel responsible and need rules to do reduce food waste. Last, while there are some opposing expectations on government strategies and other topics, classical institutional misalignments are rather rare. Even though there exists some misalignment between actors' expectations, on the contrary there also exists alignment when it comes for example to the reduction of bureaucratic hurdles in food distribution. Additionally, sanctions are also seemingly not present in the institutional landscape in Cologne.

4.4.5. Waste Prevention

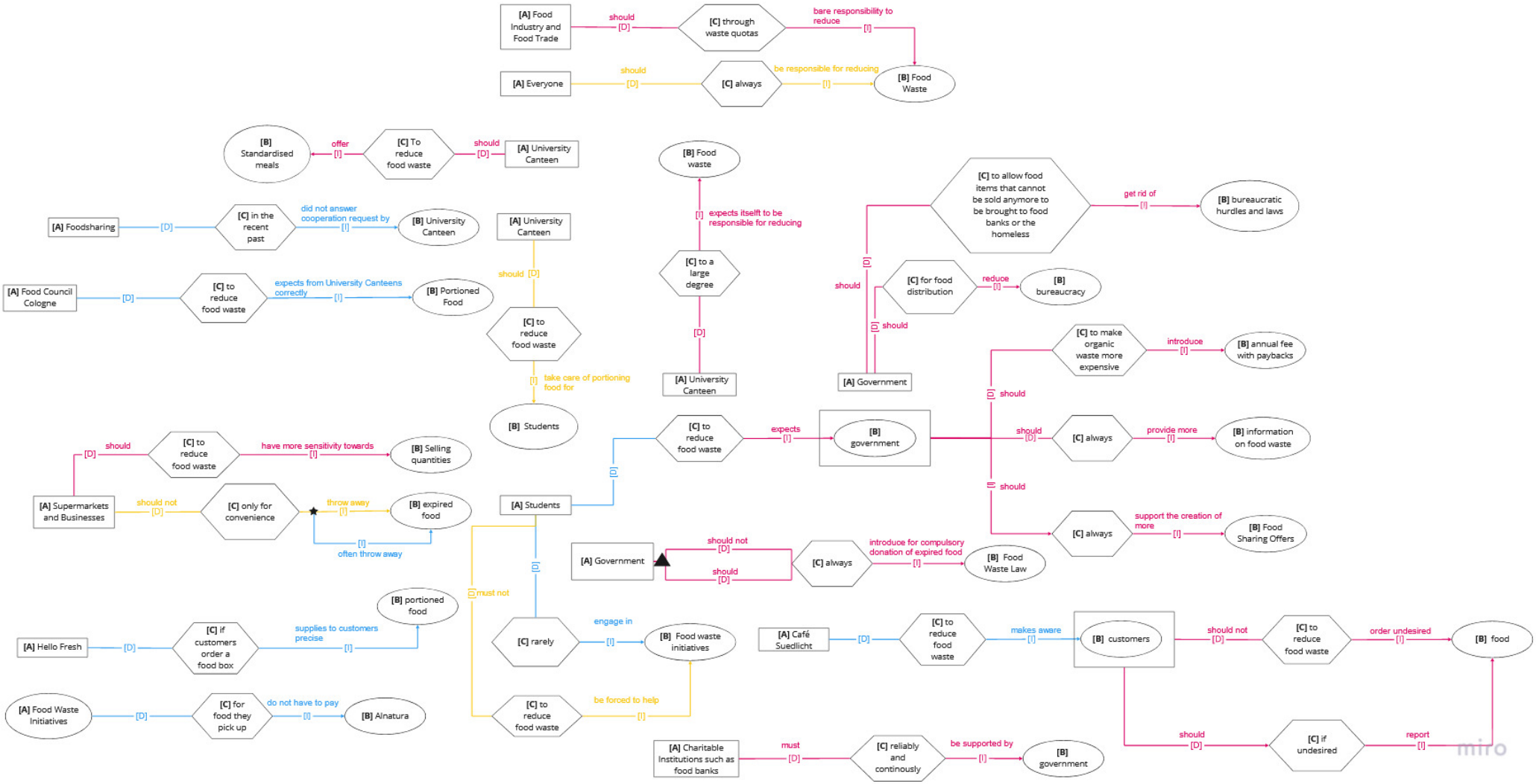

Figure 27: Institutional Network of Action Situation "Waste Prevention"

4.4.6. Waste Disposal

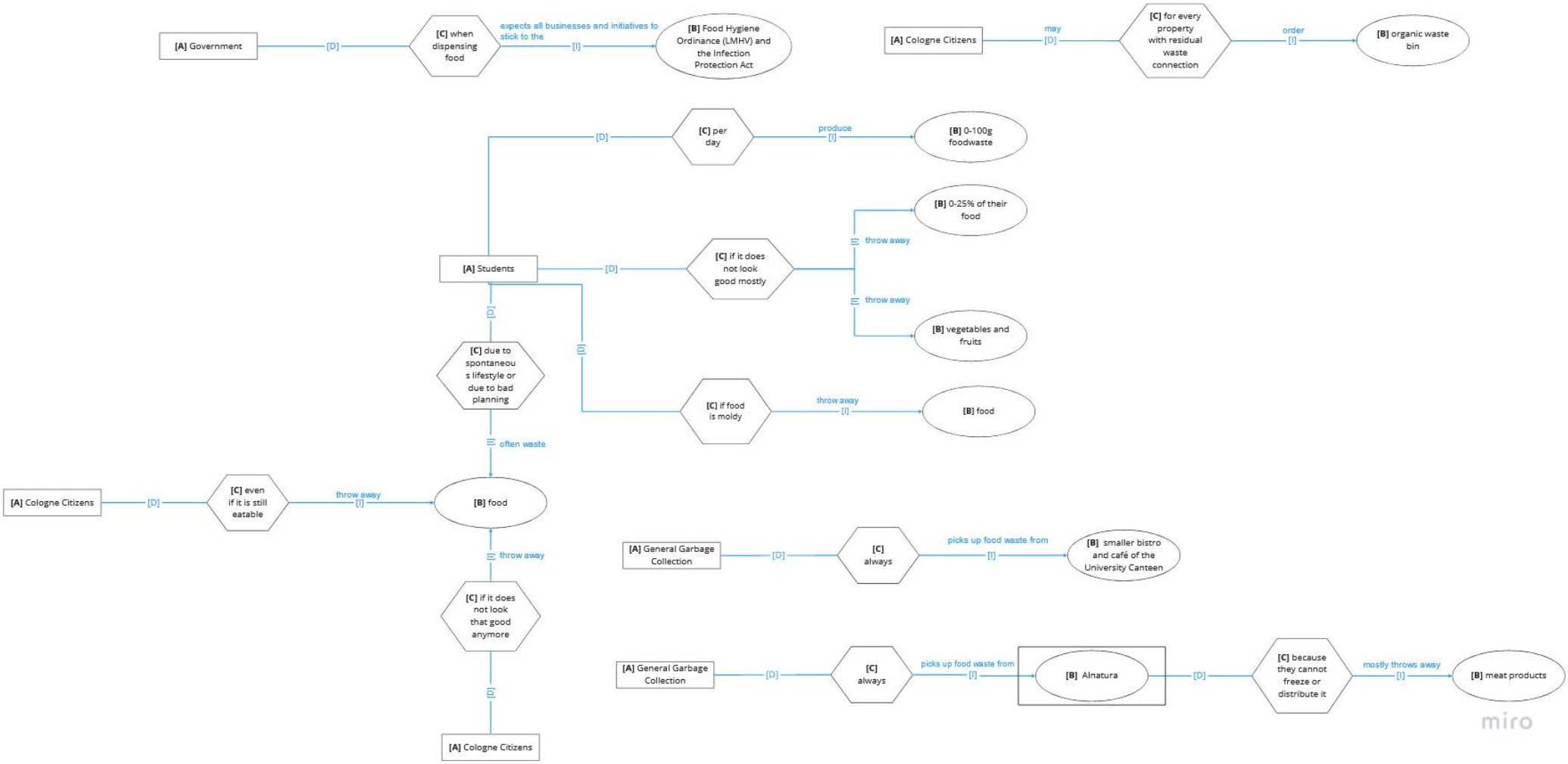

Figure 28: Institutional Network of Action Situation "Waste Disposal"

4.4.7. Waste Treatment

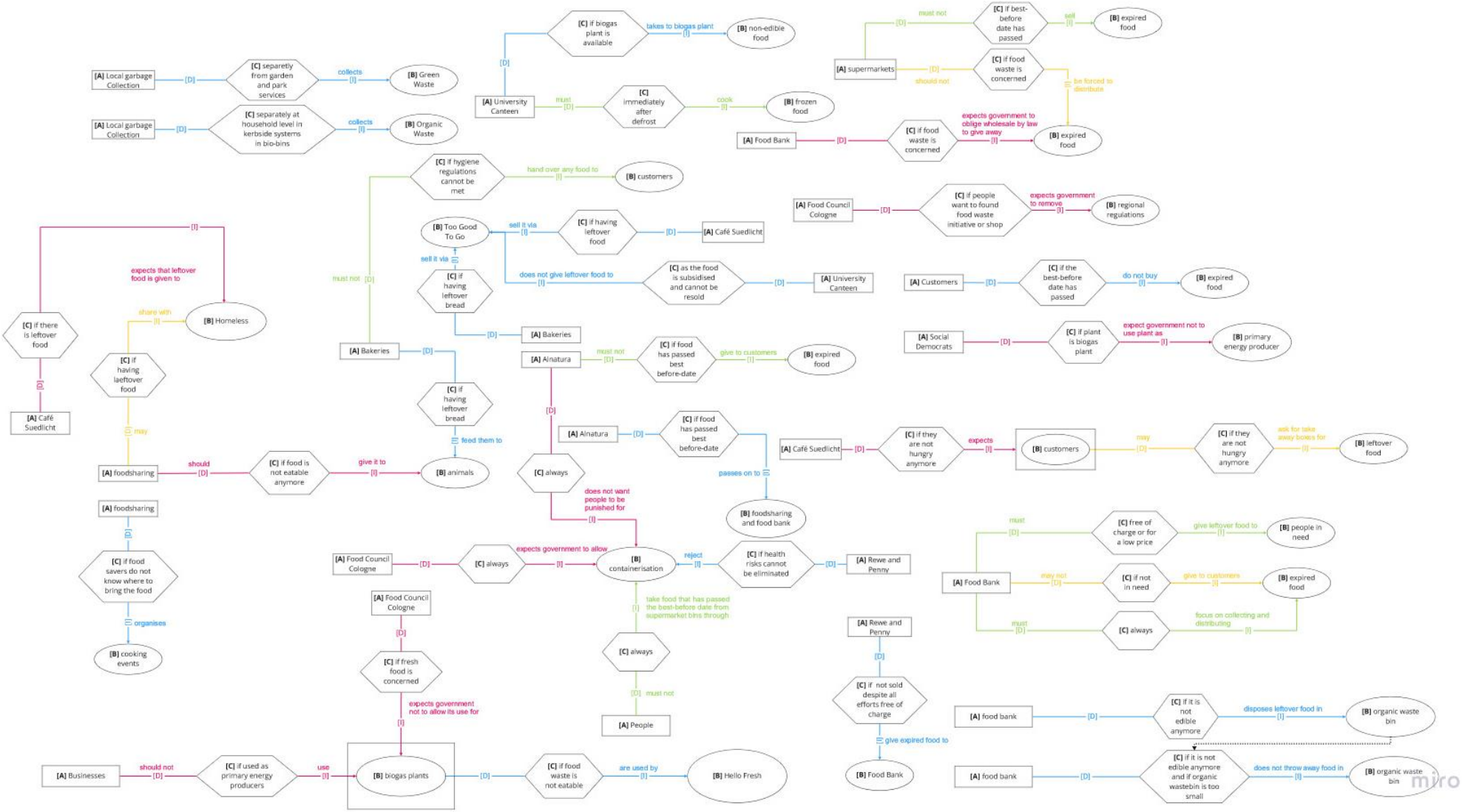

Figure 29: Institutional Network of Action Situation "Waste Treatment"

4.4.8. Sustainability Understanding

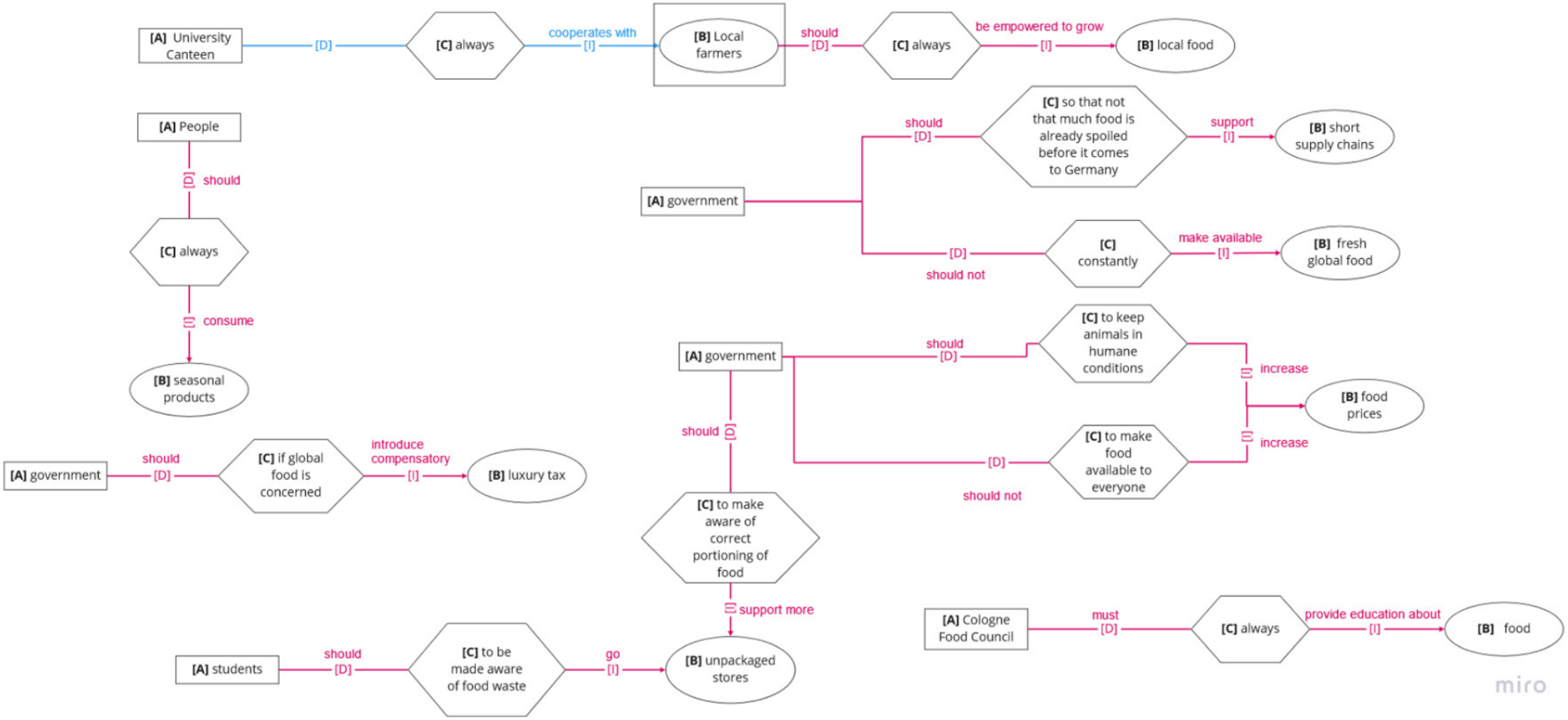

Figure 30: Institutional Network of Action Situation "Sustainability Understanding"

4.4.9. Best-Before Date

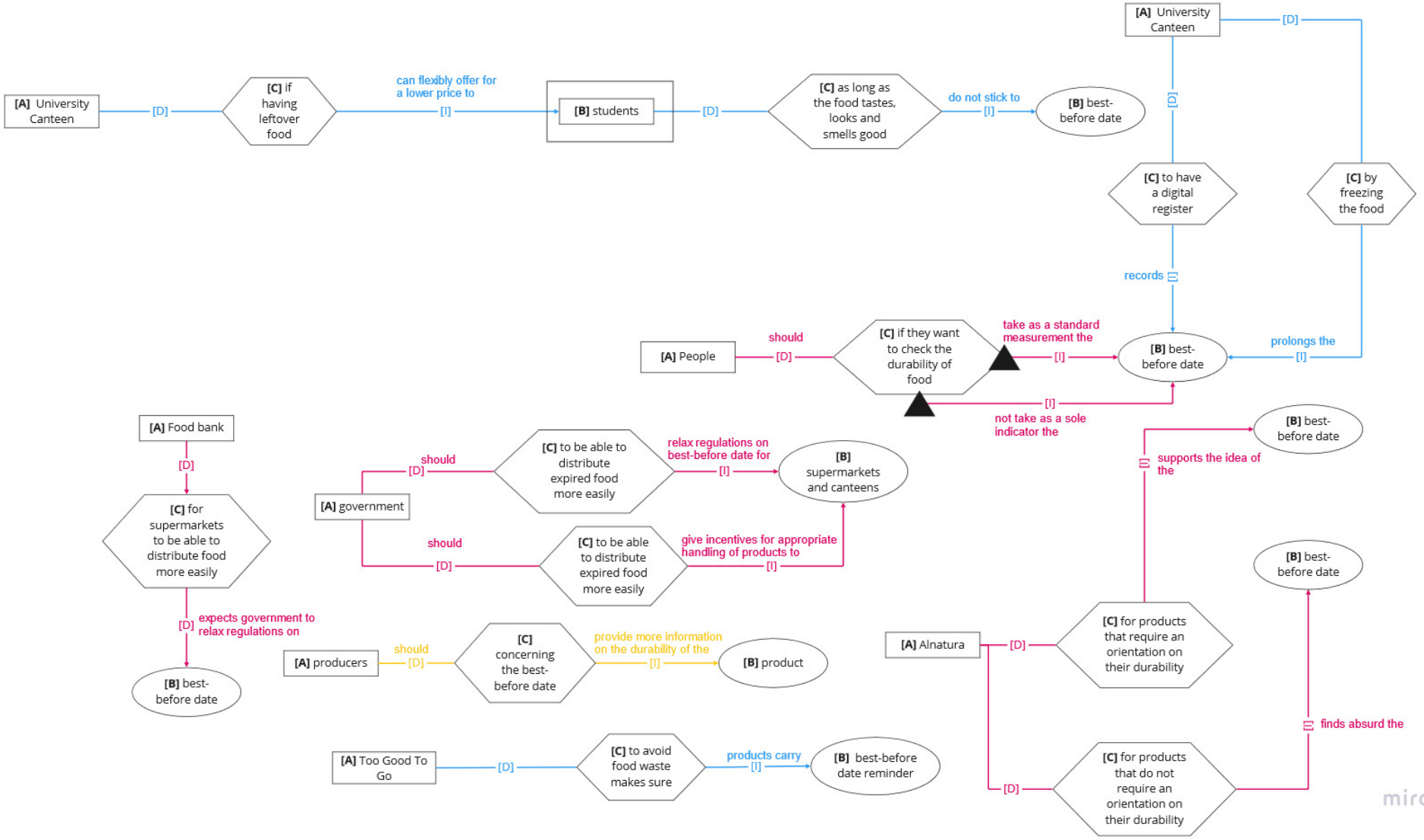

Figure 31: Institutional Network of Action Situation "Best-Before Date"

4.5. Network Metric Results

Another important element of the Institutional Network Analysis are the network metrics. There are four elements of the metric that need to be considered. Quantifying the results of the network analysis help to have a look at the network from a different angle. Therefore, this section provides an overview and a small evaluation of the results of the calculations from the degree of centrality, the network ratio, the institutional dependency rate, and the conformance index. An overview about all calculations and results can be found in Annex C.

Degree of Centrality

First, the *Degree of Centrality*, meaning "Number of links per attribute connecting them to conditions, divided by the average number of links per attribute connecting them to conditions". If an attribute has a high degree of centrality, this implies an important position in carrying out institutions of that attribute. Important to mention are the animate objects, which are newly introduced into the network diagrams. For these types of Institutional statements, only the first part, so the attribute and the first condition are taken into account for the degree of centrality, as the second part of the statement does not include a normal attribute anymore, but the animate object that is a hybrid form of object and attribute.

Range: [0, ∞]

Network Ratio

The second metric that needs to be calculated from the institutional networks and which is created newly for the purpose of this research is the network ratio. The network ratio simply shows the ratio of each institutional category (norms, rules, strategies and expectations) for the whole network, meaning each action situation. Instead of calculating the embeddedness of the objects, which was not very applicable to the networks of this research, the network ration helps much more showing the importance of expectations in the food waste networks in Cologne. The closer the value is to one, the higher is the share of that institution of the network and therefore also its importance.

Range: [0, 1]

Institutional Dependency Rate (IDR)

The Institutional Dependency Rate (IDR), it the third of four metrices, which needs to be calculated. The IDR can be calculated by counting all conditions of all action situations. A higher value for a diagram means that many institutions rely on the execution of other institutions to execute.

Range: [0,1]

Conformance Index

The conformance Index lastly looks at the relations and proportions of objects to conditions. A value of 1 implies no conformance issues, while the larger the number the more institutions face conformance issues.

Range: [1, ∞]

4.5.1. Degree of Centrality

Food Waste Prevention

Table 3: Degree of Centrality Action Situation Food Waste Prevention

Attribute	**Degree of Centrality** (Range: [0, ∞])
Food Council Cologne	0,78
Food Sharing	0,78
Supermarkets and Businesses	1,56
Hello Fresh	0,78
Food Waste Initiatives	0,78
Students	2,33
Government	1,56
Charitable Institutions such as Food Banks	0,78
Café Suedlicht	0,78
University Canteen	2,33
Food Industry and Food Trade	0,78
Everyone	0,78
Average	*1,17*

Since the degree of centrality of an action situation shows, how important certain attributes are in carrying out institutions, it can be clearly said for the action situation *Food Waste Prevention* that students and the university canteen play a central part in the network system. Additionally, the government, supermarkets and businesses also seem to be an important part of the waste prevention system. This finding is very relevant, as it shows that much importance and focus should be put to students by the government to reduce food waste, but also supermarkets and businesses must play a more important role in the future and are important parts of the system.

Food Waste Disposal

Table 4: Degree of Centrality Action Situation Food Waste Disposal

Attribute	**Degree of Centrality** (Range: [0, ∞])
Cologne Citizens	2,1
Students	2,8
Government	0,7
General Garbage Collection	1,4
Average	*1,75*

For the action situation *Food Waste Disposal*, the degrees of centrality for the different attributes are rather more diverse. While students have again the highest degree of centrality, the citizens of cologne are at second place. The general garbage collection and the government are on places three and four. Again, it is interesting to see that students are the most central element f the network, when it comes to waste disposal. As students might not take care that well of separating and throwing away waste correctly, they are a crucial element of the system. Since the students are also part of the citizens of cologne, and since the people living in cologne are responsible for throwing away their waste correctly, they are also an important part of the network.

Food Waste Treatment

Table 5: Degree of Centrality Action Situation Food Waste Treatment

Attribute	**Degree of Centrality** (Range: [0, ∞])
Local Garbage Collection	1,52
Café Suedlicht	1,52
Food Sharing	2,27
Bakeries	2,27
University Canteen	2,27
Supermarkets	1,52
Food Bank	4,55
Food Council Cologne	2,27
Alnatura	2,27
Social Democrats	0,76
Rewe and Penny	1,52
Businesses	0,76
Customers	0,76
People	0,76
Average	*1,79*

For the action situation *Food Waste Treatment,* it can be clearly said that the food bank is a central part of the system. Next to the food bank, bakeries, the university canteen, food sharing, the food council cologne and Alnatura, a bio supermarket, are other important actors to carry out institutions. The results are logical as the actors concerned are already dealing with processing leftover food and therefore already have more weight in carrying out institutions. What is surprising is though that political parties and people in general are not very central in this system. Since politics and the people themselves are normally crucial elements in shaping societal norms and rules, it is surprising to see that these actors are seemingly not very central in carrying out institutions.

Sustainability Understanding

Table 6: Degree of Centrality Action Situation Sustainability Understanding

Attribute	**Degree of Centrality** (Range: [0, ∞])
Government	4,2
People	0,7
Students	0,7
University Canteen	0,7
Food Council Cologne	0,7
Average	*1,4*

Regarding the general understanding of sustainability, the government seems to be an important actor, while the other attributes that have been identified have a rather minor importance. This finding is also interesting, as the government seems to have an important role in shaping people's perception of sustainability to a large degree.

Best-Before Date

Table 7: Degree of Centrality Action Situation Best-Before Date

Attribute	**Degree of Centrality** (Range: [0, ∞])
University Canteen	2,18
Food Bank	0,73
Government	1,45
Producers	0,73
Too Good To Go	0,73
People	0,73
Alnatura	1,45
Average	*1,14*

Lastly, concerning the bets-before date the university canteen, the government and the supermarket Alnatura seem to be mostly, important in carrying out institutions. While for the government and Alnatura this seems to be logical, since the government introduced the best-before date and the supermarkets are implementing it, it is a little surprising to see the important role of the university canteen. Since the canteen said that they are not actively trying to educate students to beave more sustainably, their work seems to have an effect in carrying out norms on how to handle the best-before date. It has to be mentioned though that the centrality of the university canteen can be explained by the focus on students in general, which might have been different, if the focus of this research would have been different.

4.5.2. Network Ratio

Waste Prevention

Table 8: Network Ration Action Situation Food Waste Prevention

# of Norms	**# of Rules**	**# of Strategies**	**# of Expectations**	**Total # of Institutions**	
4	0	7	15	27	
0,15	0	0,26	0,56		**Ratio**

For the action situation waste prevention, the network ratio shows that expectations are by far the largest part of the network. The second largest part are shared strategies. This result fits into the overall picture of this research that many actors have many expectations, especially when it comes to the question of how to prevent food waste. However, the expectations do not lead to action that is taken. Even though strategies are the second largest part of the waste prevention network, they are still overall a rather low share, which again shows that too little action is still taken by the actors.

Waste Disposal

Table 9: Network Ration Action Situation Food Waste Disposal

# of Norms	**# of Rules**	**# of Strategies**	**# of Expectations**	**Total # of Institutions**	
0	0	12	0	12	
0	0	1	0		**Ratio**

For the waste disposal network, the whole situation is different. In this network only shared strategies are part of the network. This shows that regarding waste disposal, action is taken, but the fact that no rules or norms exist might be hindering for a more effective waste disposal system. Even though there exist certain rules on waste separation, no special rules exist regarding the disposal of food waste. As the analysis above has shown, often fresh food that would be still edible goes into biogas plants. This could be prevented if there would be maybe clearer rules or alternative bins to dispose non-edible food waste separate from organic waste. Through this consumers could be made more aware of which quantities of food they really throw away and the waste management could more easily see, if the food is still edible.

Waste Treatment

Table 10: Network Ration Action Situation Food Waste Treatment

# of Norms	# of Rules	# of Strategies	# of Expectations	Total # of Institutions	
4	7	15	10	36	
0,11	0,19	0,42	0,28		**Ratio**

The action situation *waste treatment* also shows interesting results regarding the network ratio. The share of strategies is the highest, while the expectations only have the second highest value with 0,28. Very interesting to see is however that waste treatment is the only action situation in which rules could be found. While it makes sense for the general understanding of sustainability of people that no rules could be found, for the other action situations it is very astonishing that no rules, but also very few norms were found. As the descriptive results also showed, waste treatment includes the ability of supermarkets and other actors to give away expired food, or of the university canteen to freeze food and use it at a later stage. Since there are clear regulations on what could be given further and what not, this action situation seems to have the only rules in the network system. This shows again the necessity for further rules on waste prevention, waste disposal and the best-before date. Only through introducing rules, the topic might become more relevant in society.

Sustainability Understanding

Table 11: Network Ration Action Situation Sustainability Understanding

# of Norms	# of Rules	# of Strategies	# of Expectations	Total # of Institutions	
0	0	1	10	11	
0	0	0,09	0,91		**Ratio**

For the action situation *sustainability understanding* the most interesting finding is that there are no norms included in the network diagrams. While only one strategy could be found, the rest of the network consists of expectations. This makes sense in the light of the action situation, as the general understanding of people of sustainability cannot have any rules and involves normally people expecting other people to behave sustainably in different ways. However, it is interesting to see that no norms could have been found, which points to the fact that the topic of sustainability clearly also needs more attention and clarification among the people. These numbers support the need for more

educational work that needs to be done at schools, but also in general to create a common sense of what is sustainable. This could help developing a norm and a common understanding of food waste not being sustainable, which then would lead in its consequence to reduction of food waste.

Best-Before Date

Table 12: Network Ration Action Situation Best-Before Date

# of Norms	# of Rules	# of Strategies	# of Expectations	Total # of Institutions	
1	0	5	7	13	
0,08	0	0,38	0,54		**Ratio**

Last, for the action situation *best-before date*, a clear majority of the institutional statements are expectations, while more than one third are shared strategies. For this action situation only one norm could be found. These results mirror again a lack of norms. That no rules could have been found makes sense, as the best-before date can only remain a recommendation, while creating a norm to not throw away food that is still edible even after the best-before date, would help a lot to reduce food waste. Therefore, the different expectations by many actors of how to deal with the best-before date, or even if it should be called best-before date and the different strategies by the actors, especially the students, on how to deal with food that has passed the best-before date can indicate that a societal discussion and the creation of a uniform norm is in its making. Nonetheless it needs more effort by the government to pressure supermarkets and businesses to provide clearer information about the best-before date on the product itself and also promote that people should use their senses before throwing away food.

4.5.3. Institutional Dependency Rate (IDR)

Table 13: Institutional Dependency Rate (IDR) per Action Situation

Action Situation	Institutional Dependency Rate (IDR)
Waste Prevention	0,07
Waste Disposal	0,22
Waste Treatment	0,04
Sustainability Understanding	0,16
Best-Before Date	0,14

The values that the institutional dependency rate (IDR) reveals are not very high. While the Action Situation Waste treatment has the lowest value with 0,04, waste disposal has the highest rate of institutions being dependent upon each other with a value of 0,22. These overall low values show that the institutions are working rather independently from each other, meaning that they are not dependent on other institutions to be executed. This mirrors what the institutional network analysis has shown, as rules and norms are rather rare, while opposing expectations are a big part, which are not dependent on each other, but rather opposing.

4.5.4. Conformance Index

Table 14: Conformance Index per Action Situation

Action Situation	**Conformance Index**
Waste Prevention	1,00
Waste Disposal	1,09
Waste Treatment	1,00
Sustainability Understanding	1,00
Best-Before Date	1,00

The conformance Index reveals in contrast rather surprising findings. As for almost each action situation except for *waste disposal* the conformance values are 1, this shows that the institutions have no conformance issues in these action situations. Only the action situation *waste disposal* shows a value of 1,09, which means that there are some conformance issues between the institutions. This could be explained by two facts. On the one hand, the higher value and lower conformance might be a cause of the animate object that is part of the action situation, while on the other hand the diverse behaviour of students on food waste also plays a role.

Chapter 5: Discussion

"To what extent are the strategies, rules and norms of these actors in this area in line with each other?"

The aim of this study was to provide better insights into food waste management in the city of Cologne in Germany. Through an institutional network lens in accordance with Ostrom (1995), this study investigated how different actors, such as students, but also food waste initiatives, companies and retail are dealing with food waste. This section brings together the results of the literature research, the descriptive results and the results of the institutional network analysis and discusses them in the light of the current food waste management situation in Cologne. Adding an overview to the overall analysis of institutional drivers and barriers of food waste in cologne helps embedding the results of the network analysis in a broader context of results and provides additional insights into other aspects. While the discussion on the descriptive and literature results part is divided into the overarching themes that were identified, the institutional network results discussion critically engages separately with the norms, rules, strategies and expectations.

5.1. Discussion of Descriptive and Literature Results

Discussion on Containerisation

Firstly, containerisation seems to be a topic of discussion, where some actors demand the legalisation or decriminalisation of containerisation, while others, such as Rewe do not support this, due to health concerns. In contrast to this stands the expectation by many supermarkets and food waste initiatives to reduce bureaucratisation of food waste reduction. Transforming these contrasts into clear actions that make the different actors happy and that help reducing food waste would be a big task to tackle. Therefore, giving more responsibility to the consumers and de-criminalizing containerisation would be a good step to pursue for the regional government. To prevent uncontrolled containerisation by people, the government could on the one hand force supermarkets to give away their food to waste initiatives, which is not yet done in Germany, while on the other hand make the supermarkets create locations where people would have easier access to the food that is thrown away by the supermarkets. A decriminalization of containerization might be better than a legalization, as supermarkets might then throw away more food in bins, as it would be still easier for them.

Pay-as-You-Throw (PAYT)

Second, in Cologne, the trash bin system might not be as fair and precise, since the fee that is paid is an annual fee. Therefore, some people might use the bins more often than others, or just order a cheaper bin, and put other trash in other bins, to avoid paying more for the bigger trash bin. If people, supermarkets, or companies would have to pay for the trash that is really produced, the payment is more direct and fairer, as the less waste is produced the less trash bags have to be bought. If trash becomes more expensive, the actors throw less away, or store less which then would have to be thrown away. The only issue with this that has to be mentioned is that the trash bags themselves cause an environmental issue. Therefore, biodegradable alternatives should be offered.

Biogas Plants as Problems

Third, for the use of biogas plants in Germany, of which around 9000 are currently operational, the literature research has shown that there is a strong need for further investigations on how much food that is still edible is actually going into the biogas plants and how the government could prevent this or check this in a better way. As the use of the edible food gives a wrong signal to retail and consumers that food regardless of if it is edible or not can be used for energy production, this does not help reducing food waste. Since retail and consumers might think, even if food is thrown away it is used for something useful, the threshold of throwing away food becomes very low. Therefore, stricter checks need to be done to reverse this trend.

Bureaucratic Hurdles as Issues

Fourth, as it has been mentioned before, Gabriel et al. (2021) argue that German supermarkets up until now mainly engaged in food waste prevention measures to clear up their image, as food waste prevention would mean a loss in sales, which the supermarkets do not want. Interesting to see is that the supermarkets that were questioned for this thesis both claimed that there were bureaucratic hurdles to overcome when for example distributing food, or that they were not allowed by law to give food that had passed the best-before date to customers. As the interviews have shown, all cooperations between supermarkets and food waste initiatives have to be documented and also how much and what type of food is given away. Especially the retail would like to have more freedom in distributing food, to make it easier and faster. On the other hand, there are also demands for introducing a law or a regulation for supermarkets that they should be obliged to give away leftover, or expired food to the food waste initiatives. This would require however governmental intervention and a more thorough investigating of the food waste prevention strategies by retail more in detail. Since some interview respondents claimed that there are still supermarkets that do not give away expired food, but throw it away because it is easier, a more complete picture about how many supermarkets are throwing away their expired food still would be needed.

Disagreement about Governmental Interventions on Food Waste

Fifth, there seems to be dissent about governmental interventions on food waste reduction among some actors. While the green party for example rather prefers raising food prices to sensitise people about the value of food, the food bank and solidarity farming clearly reject this strategy, as this would mean that even less people could afford buying food. Students, as mentioned earlier, prefer more information campaigns and promotion of the topic of food waste to make people more aware, but also the promotion of food sharing offers. Overall, this diversity of opinions about what the government should do to reduce food waste even further shows that the topic of food waste still needs more attention through research, but also through the government and the society. Finding a good pathway in the next years will be important for the government to handle these opposing opinions, in order to try to find the best solution for all actors.

Ambivalent Role of Government in Promoting Food Waste

Sixth, the government according to the data that was gathered for this research, seems to have an ambivalent role. While on the one hand already promoting the combat of food waste through initiatives such as “Too Good for the Bin”, the government still has not yet taken action in the past years in legal terms, introducing similar laws for food waste reduction similar to the ones in France or Italy. Finding the reasons for this inaction is crucial to be able to tackle the issue of food waste in the future. The data that was collected for this thesis shows that even though a general awareness of the existence of food waste is present among the people, perceiving it as a concrete issue is not the case, which might explain the rather unspecific action that has been taken so far. Since the government is

according to the degree of centrality analysis a central actor in the food waste system, it would be necessary that the government takes action to prevent further food waste. Despite many efforts, food waste has seemingly not yet reached a stage in societal consciousness, where the importance and necessity of reducing food waste is clear to all people.

Marketing Strategies from Supermarkets seem to not always work

Last, this study cannot confirm the fact that at least the students that answered the survey are not caught by these strategies as they are not wasting much food. Since the respondents often reported that they are not wasting too much food, this can be seen as a hint for that student do not generally fall for these strategies. However, it must be noted that the survey did not specifically ask, if the respondents were influenced by these strategies. Moreover, since the survey also relies on self-reporting, the results also have to be seen critically.

5.2. Discussion of Network Results

5.2.1. Rules

Lack of Rules and Norms

To start with the discussion of the Network results, the fact that there are barely rules and norms existing in the networks, shows a lack of organisation of the issue of food waste. As there are some actors such as supermarkets and the food council that demand the introduction of food waste laws for wholesale, like in France and Italy, more steering and orientation on what to do with food waste is also wanted by some actors. In France and Italy supermarkets and other businesses are obliged to give leftover and food that has passed the best-before date to food banks or food sharing ("Italy adopts new law to slash food waste", 2016; (Pierre Condamine; Zero Waste Europe, 2020). Since there moreover still seem to be many markets that do not give away their food, as throwing it away is easier, a law could help to prevent this food from being wasted.

Creating a Legal Basis for Freezing and Defrosting Meat

In addition to the issue of the lack of clear rules for a sustainable food waste management, the rules that are existing are sometimes barriers to a sustainable food waste management. While some supermarkets reported that they cannot give further meat that has passed it’s consume-before date, the university canteen claimed that they could easily freeze meat and defrost it at a later stage, if they document it well. If supermarkets would also be provided with a legal basis for freezing meat and offering it to customers after the consume before date this would help reducing meat being thrown away. Thus, creating regulations that are facilitating retail and consumers to take care of leftover food would be necessary.

Important is to find together with the supermarkets a rule that allows consumers to buy the “leftover” frozen meat from the supermarkets, while the supermarkets can still assure that the meat is yet eatable. A rule could be that all meat that is not consumed up until the day where it would have to be consumed, goes into the freezer, from where consumers could buy the meat for a small price. Additionally, it would be important for the supermarkets to provide customers with a very clear hint that the meat has to be consumed immediately after defrosting. Through this, also legally, more responsibility could be given to the customers as well. The question for the supermarkets would remain, if this would be economically viable and effective, but it could be a good way of reducing waste of meat, which generally also produces a lot of CO2 emissions. Moreover, regular quality controls of the frozen meat would need to be done, so that the supermarkets can assure that the frozen meat has no adverse health effects on the customers.

5.2.2. Norms

Lack of a Clear Communication about Food Waste

Given these points the topic of food waste has not yet reached broad societal attention on the one hand, while clear rules are necessary to resolve the institutional misalignment that has been shown. If the government would introduce clear regulations for supermarkets so that they are not allowed to throw away expired food, this would also shape the way people would think about supermarkets throwing away food and influence this societal norm. Furthermore, although previous results show that a general awareness on food waste exists in Cologne, there still seem to be differing opinions and norms about this topic. Therefore, a clearer communication and information about food waste would be elementary to shape the societal discourse on the issue and create a uniform societal norm that contributes to reducing food waste.

5.2.3. Strategies

Unclarity about Definition of Food Waste and Expiration Date

As the results have shown, some small uncertainties regarding the definition of food waste and the meaning of the expiration date are still detectable among the actors. This again shows the need for a broader education on food waste, also in secondary schools. Additionally, from the survey results one can see that at least the respondents are mostly not sticking to the expiration date, but are rather trusting their senses to see, if the food is still good. These two points show that in Cologne the people's way of dealing with food waste might be on the one hand already in transition to a more sustainable way, but on the other and shows that the expiration date as such does not seem to have much impact on the students. This mirrors the view by other studies, such as Vowel (2019), who claim that an unclear labelling of food items leads to higher food waste. The actors seem to be undecided about the use of the expiration date as orientation for consumers. While some would like to abolish the expiration date and exchange it with the best-before date, others are more critical towards this. Therefore, a discussion on the usefulness of the expiration date, a switch towards a best-before date and providing clearer information on the products themselves, is needed.

5.2.4. Expectations

Opposing Expectations

The government is expected both, to introduce and not to introduce a legal basis for the compulsory distribution of expired food. Again, the different expectations reveal that despite all efforts that are done and a general awareness on food waste, the topic still needs a clearer structuring and framing by the government through clear guidelines and regulations. These conflicts are especially interesting to look at, as expectations can lead to establishment of norms, which are shaping human behaviors. One example for such a misalignment is that on the one hand students expect the government to support the creation of more food sharing and food waste initiatives as such, while on the other hand barely engaging in food sharing offers or other initiatives themselves. This contradiction well summarizes the opposing expectations by many actors that many people and companies would like to do more, but do not feel responsible and need rules to do reduce food waste.

Lack of Institutional Misalignments and some Institutional Alignments

Last, while there are some opposing expectations on government strategies and other topics, classical institutional misalignments among rules, norms, or strategies are very rare. Although there exist some misalignments between actors' expectations, no other institutions were found that showed misalignments. In contrast to that, there also exists alignment when it comes for example to the reduction of bureaucratic hurdles in food distribution. Additionally, sanctions are also seemingly not

present in the institutional landscape in Cologne. This lack of sanctions displays again a lack of clear binding rules for the actors, as without sanctions there is no clear incentive for companies, initiatives or individuals to change their behaviour.

5.2.5. Network Metrics

Overall, the network metric calculations show interesting results. While the conformance of the institutions among all action situations seems to be given. Only for waste disposal the institutional conformance seems due to the different strategies of students a little less given. Regarding the independency, it can be concluded that the introduction of rules and norms into the network could increase the dependency of the institutions on each other, which might help reducing food waste even further. The degree of centrality shows that for ach action situation different actors are central in carrying out the institutions. Overall students, the university canteen, supermarkets and food waste initiatives are the most relevant actors. These actors need to be much more integrated into reducing food waste in cologne, as they already have a crucial role in carrying out institutions. Lastly, the network ratio shows that the majority of institutions that were found through the institutional network analysis are shared strategies and expectations. While norms and rules, as it also has been determined earlier on, are rather rare, the rules that are existent in the networks exclusively exist in the field of waste treatment. These rules are both rules-in-form and rules-in-use according to Ostrom's (1995) definition, so they are formally written down but also exist as normative rules. This concerns mainly the treatment of leftover food by supermarkets and other businesses. Nonetheless, the fact that there are many strategies and expectations show that a general awareness on food waste seems to be present in Cologne, but the topic needs more time and especially political support and support by the supermarkets to become societally broadly excepted. In the following the network diagrams that have been created are shown. Furthermore, after the network diagrams, policy recommendations as a part of discussing the results in the light of food waste in Cologne are formulated. Last, a conclusion is drawn.

Chapter 6: Conclusion

6.1. Answering the Research Questions

This research has dealt with researching rules, norms strategies and behaviour of many different actors to answer the following research question: *How do Institutional Barriers and Drivers influence Food Waste Management among students and food waste initiatives in Cologne?* The main aim was on the one hand to get some insights on the food waste behaviour of students, their strategies and norms regarding this topic, while on the other hand investigating the strategies and the general way of dealing with food waste of the initiatives, companies and canteens. While other studies on food waste in Germany have not dealt with the institutional side of the issue, this research has used Ostrom's Institutional Grammar (IG), to be able to analyse the norms, rules and strategies. The policy recommendations formulated hereafter bring some new aspects into the area of fighting food waste. From the results nine policy recommendations were formulated.

6.1.1 How does the organic waste management system work in Germany and Cologne?

The first Waste Disposal Act of 1972 decided that Waste Management is generally decided by the federal government, while the different states in Germany can supplement and concretize their waste management by law. The idea of a separate collection of organic waste came about in 1983 and was eventually made mandatory through the *Law on Closed Cycle Management* in 2015. While household bio and organic waste is collected by the general garbage collection AWB and brought to kerbside systems for further treatment. A separation between organic and bio waste from food waste is done

to be able to use the food (organic) waste in biogas plants. Other treatment options of organic (food) waste are composting and combustion. Composting is done to create new soils and fertilizer, while only waste that has no additional value is combusted. Next to the legislative and technical management of food organic waste, Cologne in particular has joined and initiated several initiatives and events to combat food waste management. While "Städte gegen Food Waste" (Cities against Food Waste) is a joint initiative of ten different cities in the region that are creating a road map to reduce food waste, "Köln isst joot" (Cologne eats well) was a local project, where events about food and food waste were held a whole month. Given these points it can be said that the organic and food waste management in Germany has a clear hierarchical structure from federal to state level. There are clear rules on how the waste has to be sorted and treated. Additionally, the city of Cologne is engaging in many initiatives to raise awareness on the topic and make the citizens manage the food waste better themselves.

6.1.2. What is student's behavior on food waste in Cologne and what do the students do to prevent food waste?

Answering the question of student's food waste behaviour in Cologne further helps understanding a little bit better the motivations and reason for student's food waste behaviour. The survey results overall show that the respondents on average were quite aware of food waste as a problem and were also trying in their daily life to reduce food waste as much as possible. The respondents are on average taking care of their food consumption behaviour. While the students on average are planning their food purchases almost every time, they are on average only going grocery shopping one to three times a week. To continue, the students that were asked found changes of daily plans and cooking proper portions the biggest challenges to food waste. However, most of the respondents are already buying less food, or buying more consciously to prevent food waste at home. One relevant information that needs to be mentioned is the mismatch between the students' expectations for the government to increase food sharing offers to reduce food waste and their own low engagement in food sharing offers. Nonetheless, it can be concluded that the respondent's group was on average well aware of food waste and trying in different ways to reduce food waste.

6.1.3. To what extent are the actors' institutions in this area in line with each other?

Concerning the relation of the institutions of students to the ones of food waste initiatives, companies or canteens and their (mis-) alignment with each other, the analysis has shown that the biggest misalignment lies in the opposing expectations of the many actors. The misalignments among the expectations concern mostly the way how food waste should be dealt with by the government. There exist some differing expectations on what the government should do. The students, who are in favour of providing incentives for further food waste initiatives and also creating a different waste disposal system with paybacks, have a different opinion than the retail or the initiatives as such, who are rather in favour of a reduction of bureaucracy for distributing food. The different expectations are accompanied by only very few rules, which can be seen as another misalignment in the institutional network of food waste management in Cologne. Introducing rules would mean an alignment of at least expectations on which there was a broader consensus before. This would include having more information campaigns to reduce food waste and the de-bureaucratisation of the food distribution system for food donors. For these expectations, a general alignment of expectations could be found. Otherwise, it can be concluded that the institutional network does not show many misalignments, but also not many alignments, but can be rather seen as a functioning rather independent from each other. Therefore, politics play a crucial role in transforming the institutional landscape on food waste in Germany and providing clear rules and incentives to align the institutions in the system much more. If politics is able to bring more alignment into the networks through intervening in the system, an even

more effective food waste reduction is possible in Cologne. The interventions and actions that can be done to achieve this goal are presented in the policy recommendations below.

6.1.4. How do Institutional Barriers and Drivers influence the Food Waste Management among students and food waste initiatives in Cologne?

The results and discussion have shown that there are numerous institutional barriers and a few drivers that influence the food waste management of the different actors in Cologne. The most important barrier that has to be mentioned are the opposing actors' expectations on what has to be done to effectively deal with food waste. While the students demand more food sharing offers and information campaigns on food waste, the supermarkets and the food council request a de-bureaucratisation of food distribution to food sharing offers. Other actors such as the food bank demands that the government introduces laws that oblige supermarkets to give away their expired food. Especially when it comes to the definition of food waste, the different perceptions of the different actors show that a uniform definition that is understood by everyone is not existent.

This conflict shows that food waste is not yet important enough of a topic and leads to disorientation among the actors, so that clear rules are necessary to on the one hand create more awareness and shape new norms and on the other hand regulate food waste behaviour by individuals and companies. As retail also remains to be a large source of food waste, many supermarkets and companies would like to have more clarity on how to distribute and deal with leftover food by the state government. Even though in Germany there exist laws on how organic waste must be disposed, or how to handle leftover food, there is still too little clarity on distributing food to food waste initiatives. A solution must be found by the federal and state government of North Rhine-Westphalia on overcoming these hurdles for food waste reduction, by giving clear guidelines for consumers and retail how to effectively reduce food waste.

The different expectations create a diffuse institutional landscape, in which uniform norms on food waste cannot be created. Another important institutional barrier that can be connected to the opposing expectations is the lack of norms and rules in the area of food waste. The analysis has shown that not only norms and rules are rather rudimentary, but also a common perception of responsibility on dealing with the issue of food waste and a common understanding of food waste are lacking. As there are not many regulations regarding food waste, except for supermarkets that can only distribute certain food to food waste initiatives, together with no clear rules for supermarkets on giving leftover food to customers, this institutional void can additionally be seen as barrier to the successful reduction of food waste in Cologne. This shows that the topic despite all efforts that have been done so far in Cologne has not reached a broad societal consensus, as differing expectations on responsibilities and differing understandings of the issue are hindering food waste being perceived as a broad societal issue and being reduced through rules.

The institutional drivers that were found are on the one hand side the few rules that exist on food waste treatment and on the other hand the generally large awareness of the topic of food waste among the different actors. The rules that exist regarding food waste treatment help the actors have a clearer understanding and clearer guidelines on how to manage food waste. This can be seen as a driver since the results otherwise show that a certain disorientation exists among the actors on wat to do. The second point of the large awareness helps additionally, since interventions that aim at reducing food waste are met by a general understanding of the actors, which can accelerate the transition towards a society that wastes less food and a norm and rule creation.

Given these points and to answer the main research question, it must be concluded that there are still more barriers than drivers regarding food waste, which must be reversed. The barriers hinder the food waste management system of working more effectively and being able to handle and reduce

food waste even more in Cologne. While the drivers can be seen as potential opportunities for an improvement of the system, it is the governments task to find solutions to use these potentials to transform the system and to reduce the barriers. In order to do this, the following abstract provides nine policy recommendations.

6.2. Policy Recommendations

The results and discussion above have shown that in Cologne there still exist numerous barriers that hinder the actors on reducing food waste even further. Although the city of Cologne is engaged in promoting food waste through information events such as “Köln isst joot”, “Schad Dröm” or “Städte gegen Food Waste” and the actors interviewed and questioned showed a general awareness on food waste, numerous modifications are necessary to lower food waste even further in Cologne. Given these points, nine policy recommendations were formulated that may help reducing food waste in Cologne among students and other actors even further, which are summarised in Figure 32 and Figure 33.

Financial Support for Food Waste Initiatives

First, the federal or regional government should support food sharing offers financially, so that these are able to pay the people that are saving the food at least a small allowance. The financial support by the government could allow these initiatives to pay their employees a small fee, which could additionally motivate more people to join the good cause. This again could lead to a big upscaling of these offers, which is necessary to deal with the yet big amounts of food that is thrown away by retail.

Further Promotion of Food Waste

Second, the promotion of and provision of information on food waste remains an issue. Therefore, a clever and realistic anti-food waste campaign would be needed, which is capable of addressing all people and make them understand the importance of food. Especially at kindergartens, high schools and Universities it is crucial to inform young people about food waste, as the analysis has shown that students are a crucial part of the food waste system.

Clear Regulations for Supermarkets and Other Businesses

As guidelines already exist, forcing retail and consumers to reduce their food waste would be an option to also create norms and more valuation of food in general. As there are still markets that do not give away food, but just throw it away, because it is the easiest option, a law to oblige supermarkets to hand out leftovers, could help reduce more. Providing clear rules to supermarkets and other actors gives these actors orientation and what they can and should do to prevent further food waste and what not. Through this enforcement the actors might learn that distributing food is not too difficult, if the distribution system works well. This again gives them a good experience with distributing food, which could in the long-term lead to that enforcing rules leads to the creation of norms since supermarkets might like the new system and bring other to also do it. Additionally, the government should clearly and openly communicate to the actors concerned, which measures are possible and which not to prevent food waste, to counter the opposing expectations. If the government openly communicates this the actors and private households, better know which measures are possible at the moment and might lower their expectations.

Reduce Bureaucracy for Food Donors Through Digitalisation

Fourth, the government should reduce bureaucracy on food distribution, so that food can be distributed more easily. The introduction of a law that would force supermarkets to distribute food is

seen as an additional hurdle to facilitating the food distribution. Therefore, digitalising the food distribution system would make it possible to legally oblige supermarkets to distribute food, while also facilitating the process a lot. Therefore, creating a digital platform, where all supermarkets and donors can show which food items were given away could facilitate the whole process a lot.

Legal Alignments for all Products on the Best-Before and Expiry Date

Fifth, since there are some misalignments when it comes to the best-before date, a legal basis for wholesale would be needed, especially when it comes to meat. Creating uniform guidelines and regulations for supermarkets that they would also be able to freeze meat and give it to consumers even after the consume until date has passed, would be a necessary step to take.

Clearer Labelling and Provision of Explanation on Packaging about Best-Before Date and Expiration Date

Sixth, a clear communicating by the government and the supermarkets would be necessary. This would for example include a clear labelling of the products and explaining what the best-before date and the expiration date mean and what it means for each product individually. Especially a distinction between “expiration date” and “best-before date” for different products could help the consumers. While the expiration date would be used for products, for which it is necessary to stick to the date, such as meat, the best-before date could be used for products, which are also edible after the best-before date has passed, such as canned food.

Stricter Controls of Biogas Plants

Seventh, since in Germany there seem to be leftovers being used for biogas production that are still edible, stricter regulations and controls by the government for the biogas plants are necessary. As the edible food that is used for the biogas production could otherwise be given to the food bank and the many people that cannot afford to buy food in Germany, this is a crucial step that would need to be taken by the government.

A Pay-As-You-Throw Approach

Eights, as Cologne has a Waste-Bin system, which might not be as fair and directly accountable for the waste that is truly generated per household, a Pay-as-you-throw (PAYT) system could also help reducing food waste further. Especially for students it might be also attractive, as they usually have a low income and therefore would probably prefer a pay-as-you-throw system.

Giving Consumer More responsibility by de-criminalising Containerisation

Last, as containerisation also seemed to be a crucial point of discussion, a de-criminalisation of containerisation could lead to more food being further used that would otherwise have been thrown away. While a legalisation of containerisation could lead to the fact that supermarkets only throw away their food and do not give anything to the food waste initiatives, a de-criminalisation might be a good middle between banning and legalising containerisation.

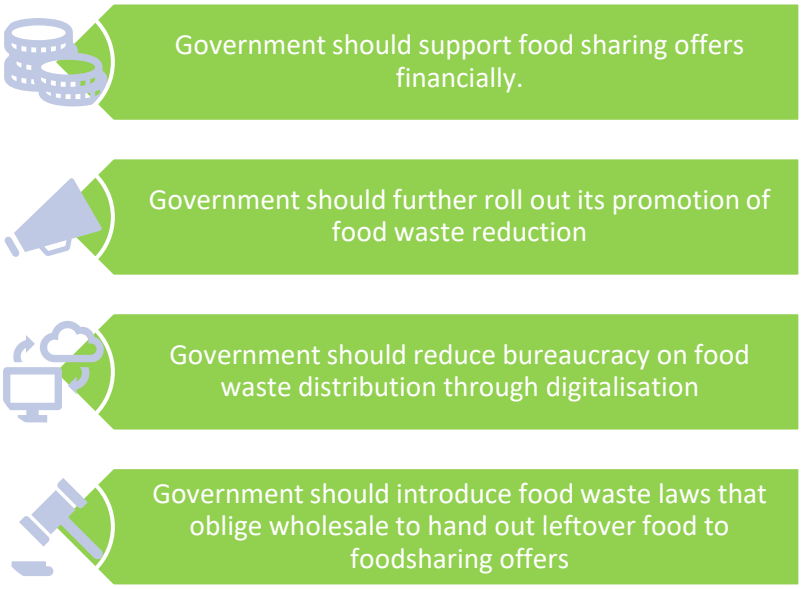

Figure 32: Main Policy Recommendations

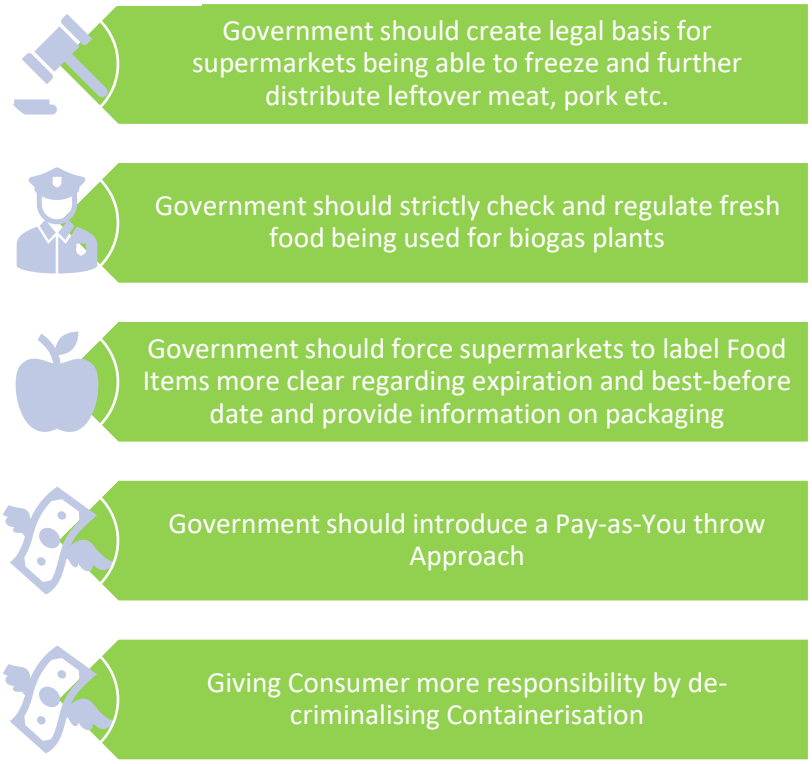

Figure 33: Main Policy Recommendations

6.3. Limitations

One of the main limitations of this research is the data collection, meaning that data is based on self-reporting of students and other actors through interviews and the survey. Especially, when it comes to measuring the exact amount of food wasted, it is as in many other studies on food waste not easy to determine the exact amount of food waste, as food waste as such cannot be measured inch perfect. A standardized way of conducting research on and working with food waste measurements is necessary to improve the comparability of results. Regarding the chosen analytical method, it can be said that it suited the research rather well. As the studies that have been done so far on food waste in

Germany, or in other countries normally tend to be of a more quantitative nature, using the Institutional Grammar (IG) as a qualitative method provides new insights into the research. Using a survey format as an additional data collection source for extrapolating the institutions of the students can be seen as a more reliable source of information for creating the institutions, as the number of respondents is much higher, while at the same time not that many institutions can be extrapolated from one and the same actor. Therefore, it can be concluded that using surveys for data collection to perform an institutional network analysis can be seen as a good complementary method next to interviews and desk research. Additionally, what needs to be considered when looking at the institutional network results is that the selection of institutional statements was done subjectively. Thus, with the same institutional statements, a different network analysis could have been performed, if the statements were coded and interpreted differently.

To continue, one reflection that needs to be mentioned is that the next time such a study would be conducted, a better harmonization of interview questions and survey questions would be necessary to extract results that speak to each other more easily. As this study showed that there are many expectations of different actors, asking more for concrete actions of actors would also have helped to see, if the expectations are fulfilled or not. Furthermore, the recommendations that have been formulated always have to be seen from an institutional point of view, as they have been formulated, for example, without taking into account the economic situation of the city of Cologne or the state of North Rhine Westphalia. Additionally, the recommendations that have been formulated are specifically meant for the city of Cologne, since the case study was exclusively done in Cologne and therefore the generalizability of the results is questionable. Nonetheless, as some information on the general food waste management in Germany were presented as well, the results might also be applicable to other regions in Germany.

6.3.1. Validity

For the external validity it can be said that the results are not generalizable as such, because the case of cologne is still very specific and not transferrable to other cities. However, the results of this thesis can give hints and a general direction about the food waste behavior and what can be done to improve it. For the internal validity the dependent and independent variable have to be defined. The dependent variable can be seen as the food waste management of the different actors. The independent variables are the rules, norms and strategies of the different actors that potentially influence the food waste management. The internal validity can be seen as rather weak, since rules, norms and strategies are not the only explanation for the actor's food waste management.

6.3.2. Reliability

The study can be seen as reliable, as the selection of respondents for the interviews, surveys and food waste diaries is done systematically. The survey, which was conducted to extrapolate institutional statements from students, cannot provide reliable statistical data due to a limited number of participants. Since it cannot be assured that, if the study would be repeated with different students that similar results would be the case, this limits the reliability of the thesis. However, generally the repeatability of the thesis is given, and triangulation has been used to combine different data sources and methods, therefore it can be said that the research is reliable.

6.4. Reflection on Results and Recommendations

As the results show there are several points that should be addressed by the government to reduce food waste in Cologne, but also in other areas of Germany even further. While some of the recommendations that have been formulated are already being executed by the government, such as the communication aspect of food waste, further efforts need to happen to create a system, which reduces food waste even much further. Important to mention is that the recommendations that have

been formulated, due to the limited scope of this research, cannot take into account all aspects of the decision-making process, such as economical or legislative barriers.

The recommendations rather serve as a guideline on the basis of which further decisions can be taken considering other aspects that are relevant for the decision-making process. Especially when it comes to financial support, the introduction of news laws, or regulations, a recommendation can be given, but if the means, especially financially are not given to subsidise certain initiatives then the recommendation can be neglected. Additionally, if the government would support initiatives financially, this could lead to the creation of further initiatives, but also more competition among the initiatives. Thus, follow-up effects also would need to be considered.

To continue, it must be pointed to the fact that the recommendation to de-bureaucratise the distribution of food or introduce more binding laws already has been discussed but would indeed lead to a greater complication of the whole process. If the city of cologne would make the distribution of food for example mandatory, as it is in France and Italy now, they would also have to ensure that this measure can be checked by some authority and that there is enough personnel and financial capacity to push through the measure. The recommendation for having a best-before date for products, for which it is necessary and an expiration date for products for which it is necessary, is something that might have already been discussed but could not have been pushed through. The same accounts for the recommendation of giving clear regulations and rules for supermarkets and other businesses, to indirectly create norms and counteract the opposing expectations. The idea as explained in the discussion is subject to many uncertainties and is not guaranteed to work. Due to the limited scope and the different focus of this thesis, more research would have had to be included to see, if this recommendation could practically lead to resolving the issue of opposing expectations and create norms.

6.5. Further Research

Further research therefore should focus on the one hand on the ability of the state government to pursue these objectives and to repeat the study in other areas. As strategies, norms and rules are the backbone of people's behaviors, it is important to study them in different regions more thoroughly, to be able to get a comprehensive picture on food waste. Only once this is completed, more concrete and differentiated actions can be taken to eliminate most of the food waste in retail and households. Another interesting aspect that could be pursued in further research is the fact that most research in Germany so far has looked at food waste at the retail and consumption stage, whereas the disposal phase has been neglected a little. As in Germany biogas plants are still fed with food that would have been edible, it is important to have a closer look at the mechanisms and responsibilities for this.

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Appendix A

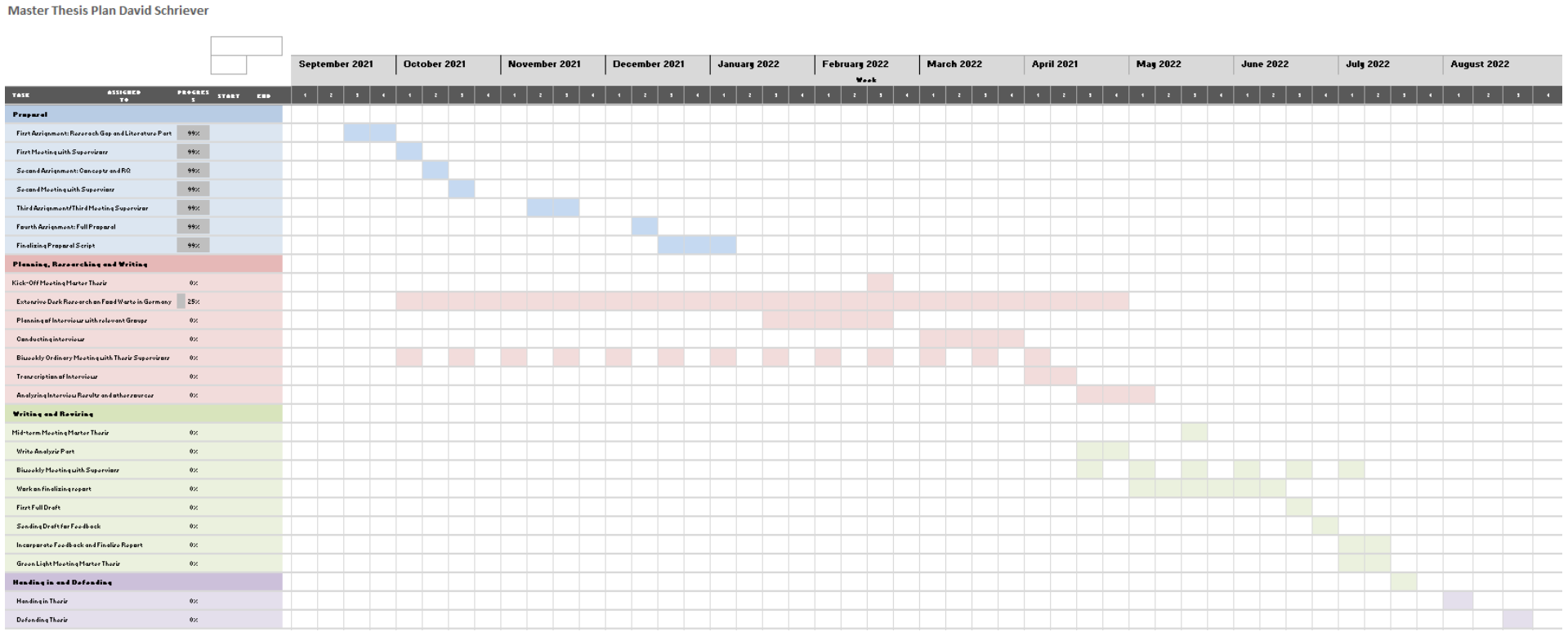

Figure 34: The Research Schedule

Appendix B

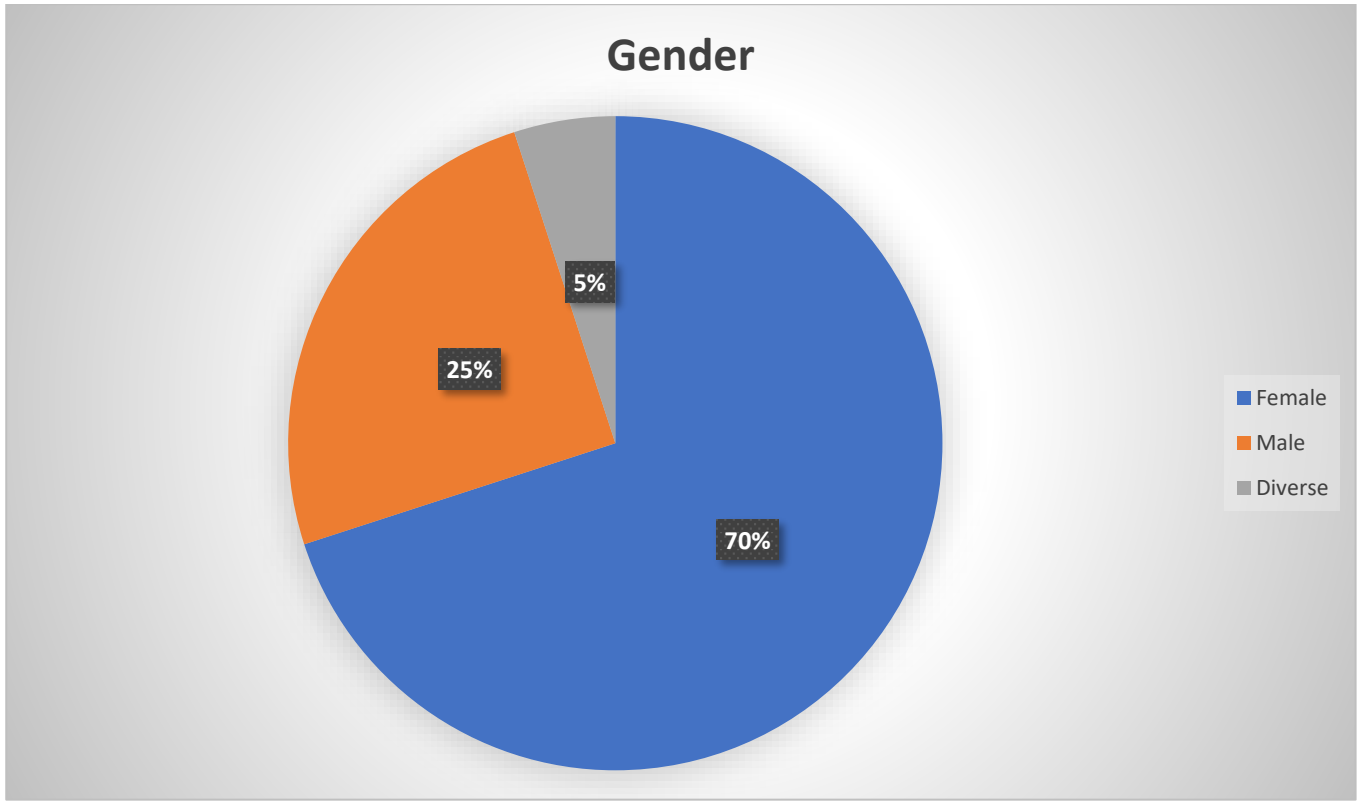

Figure 35: Gender

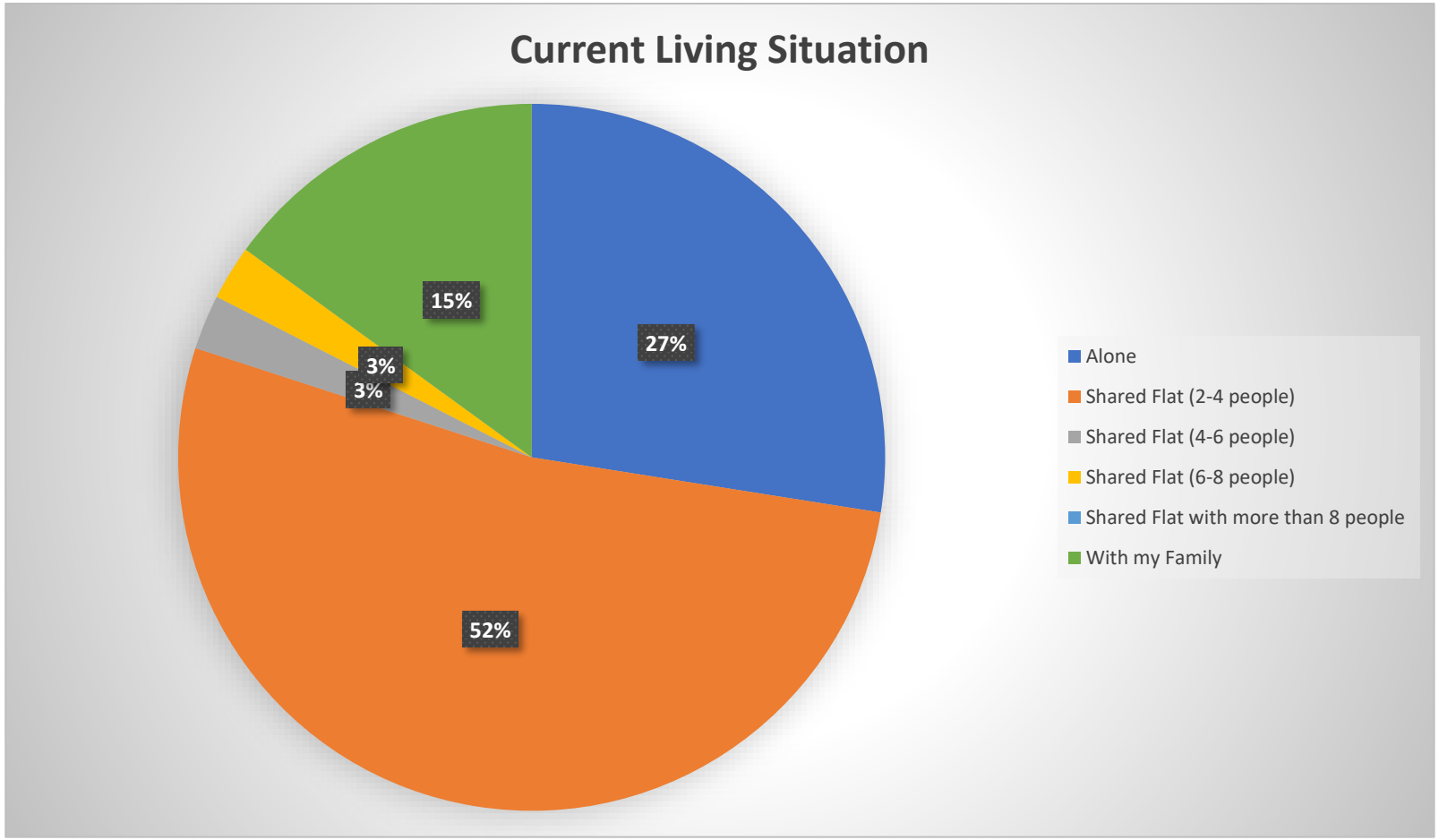

Figure 36: Current Living Situation

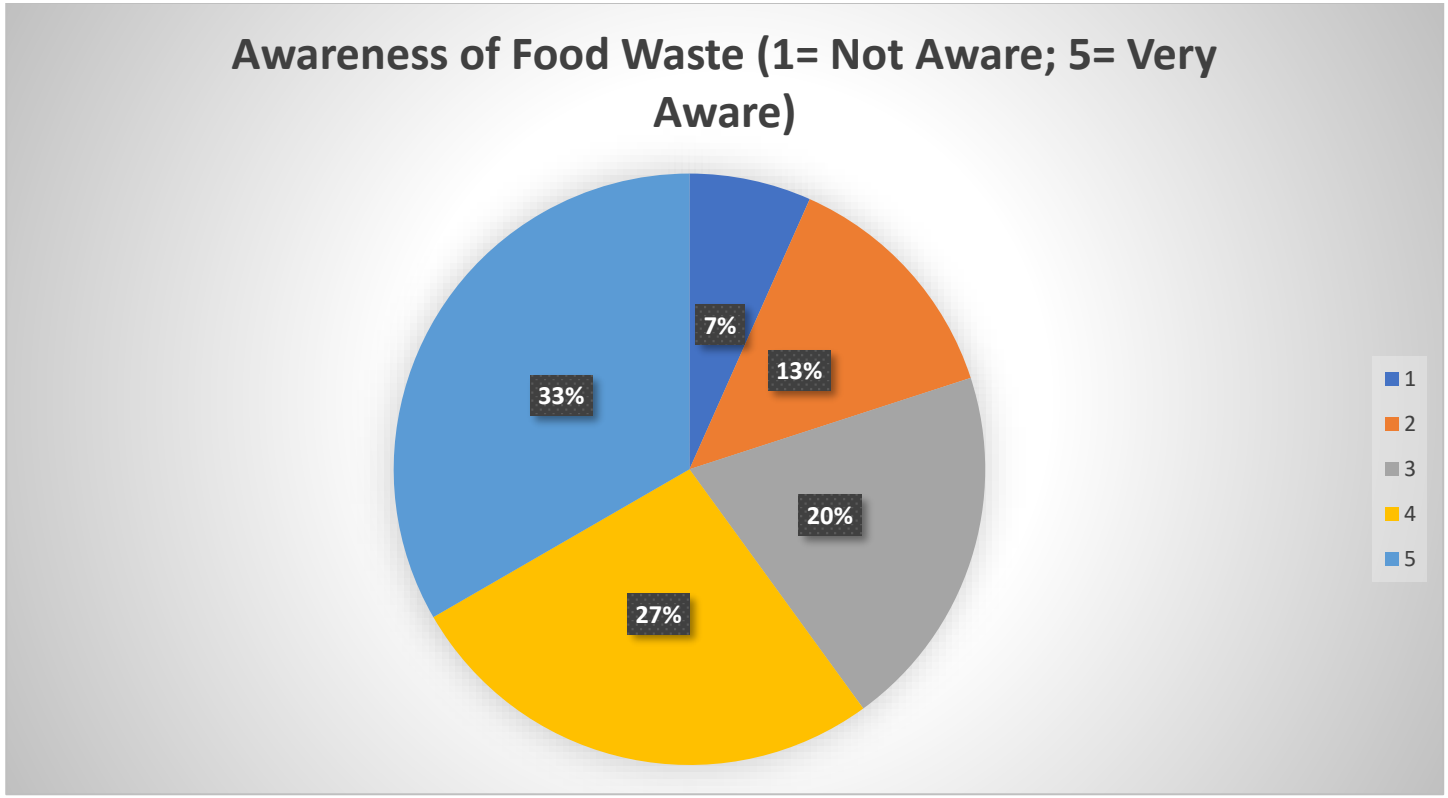

Figure 37: Awareness of Food Waste

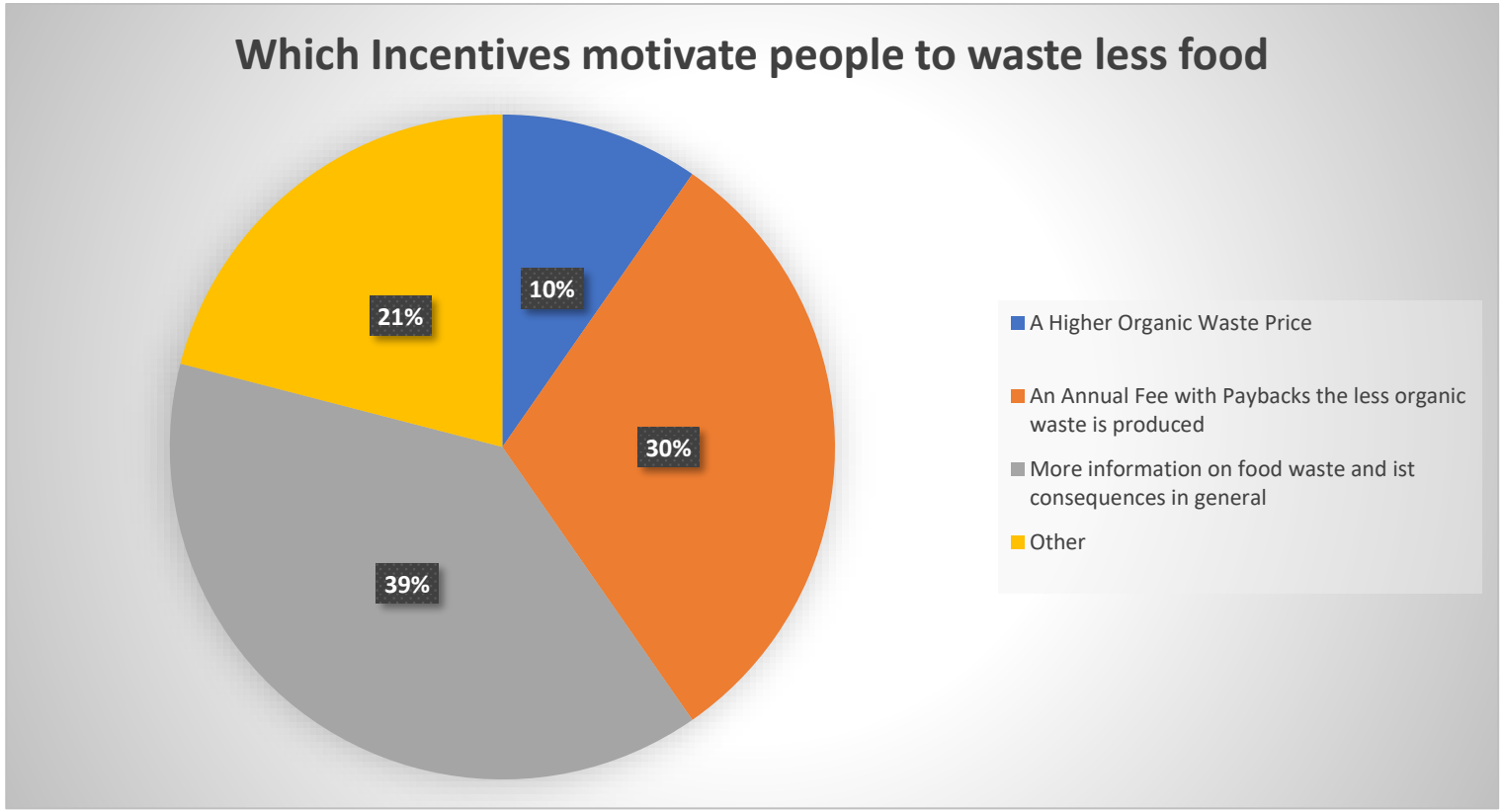

Figure 38: Incentives to Waste Less Food

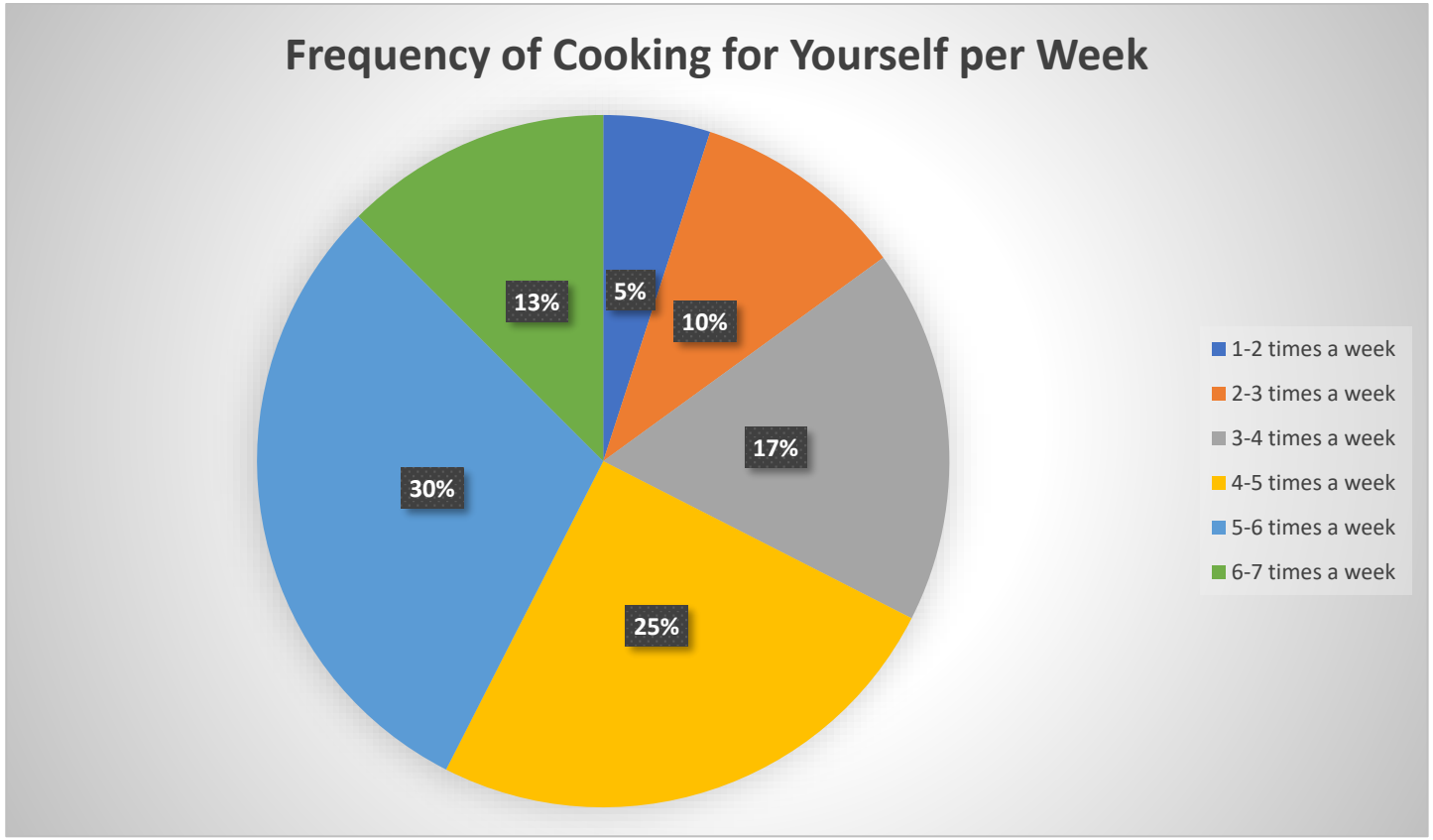

Figure 39: Frequency of Cooking for Yourself per Week

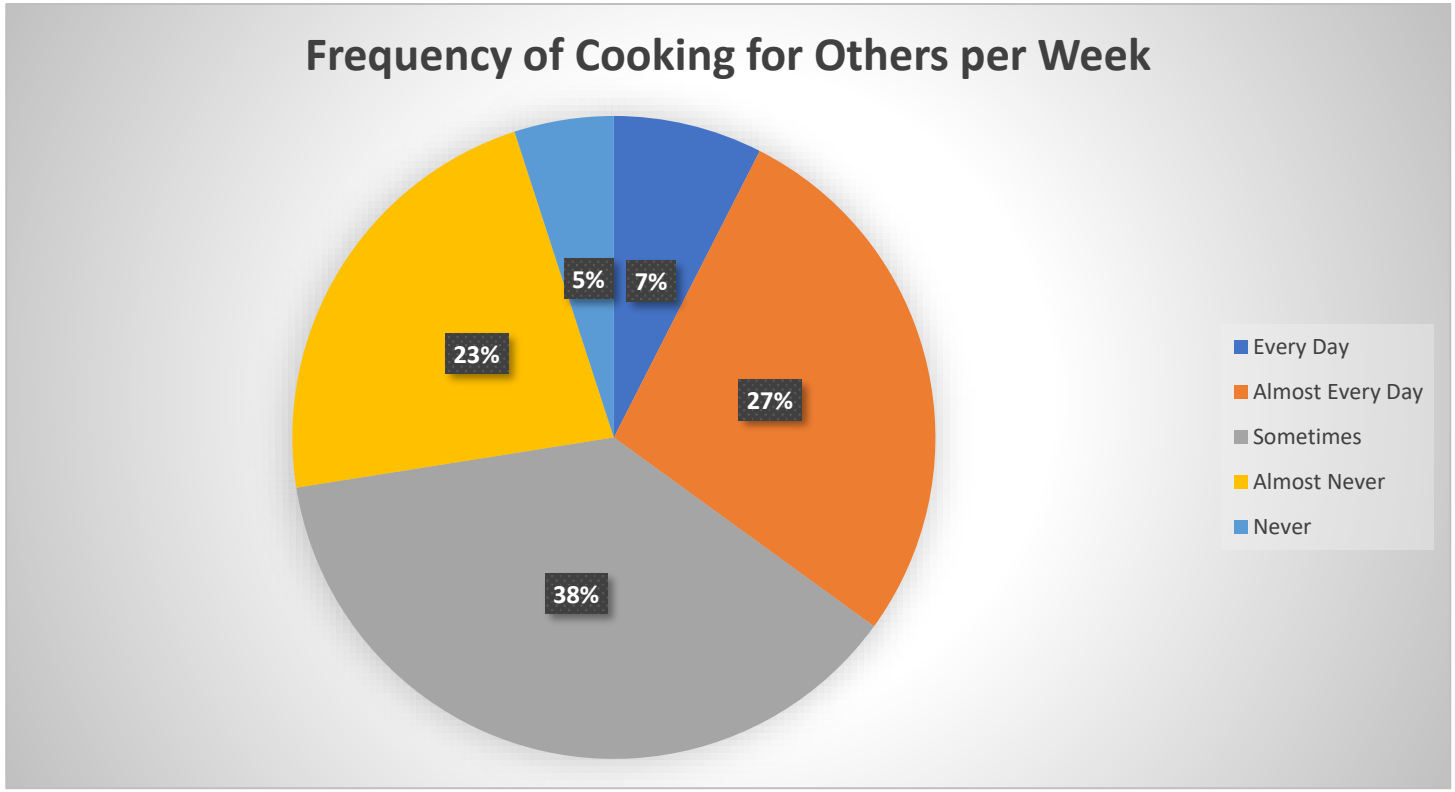

Figure 40: Frequency of Cooking for Others per Week

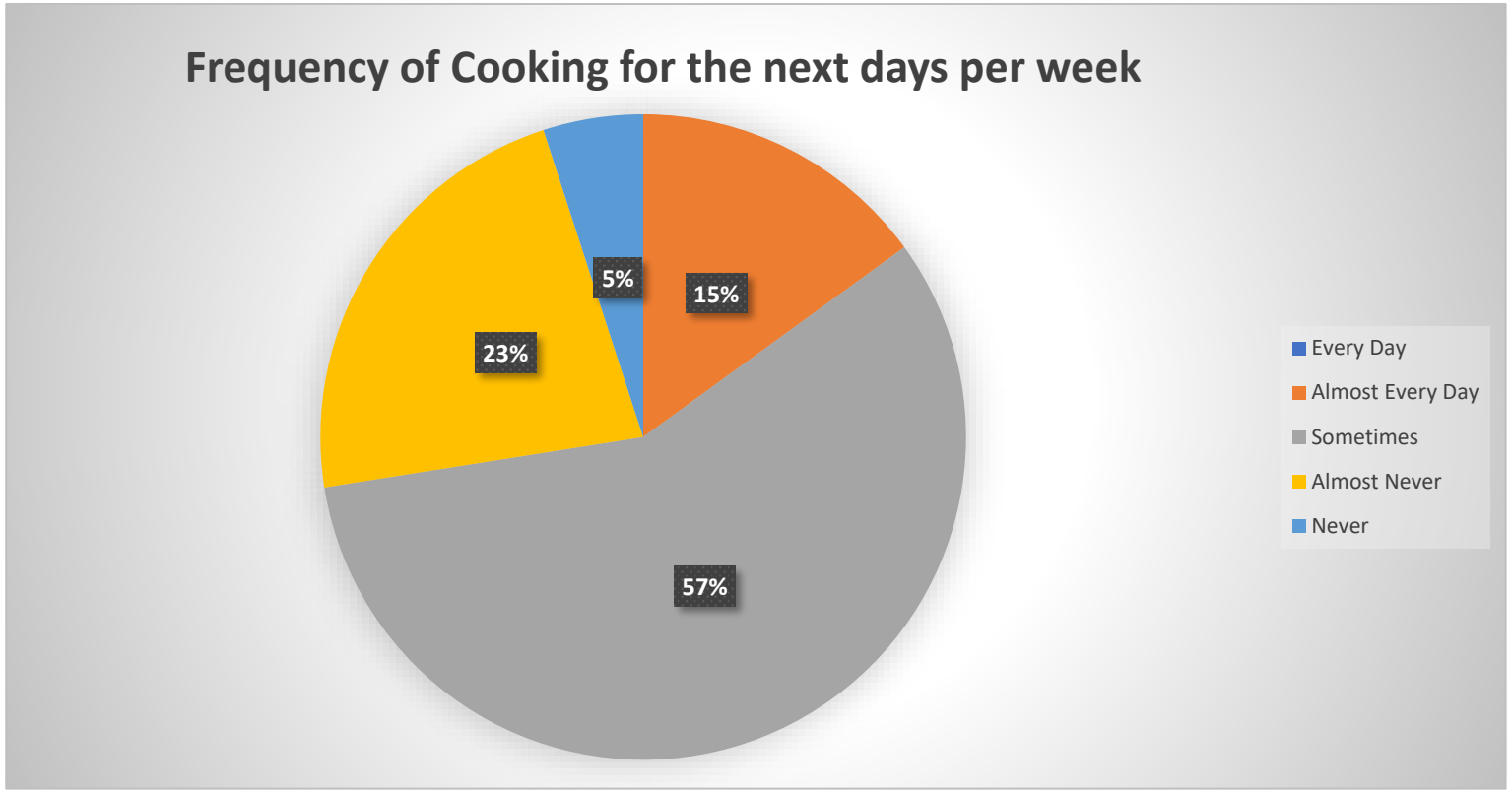

Figure 41: Frequency of Cooking for the next Days per Week

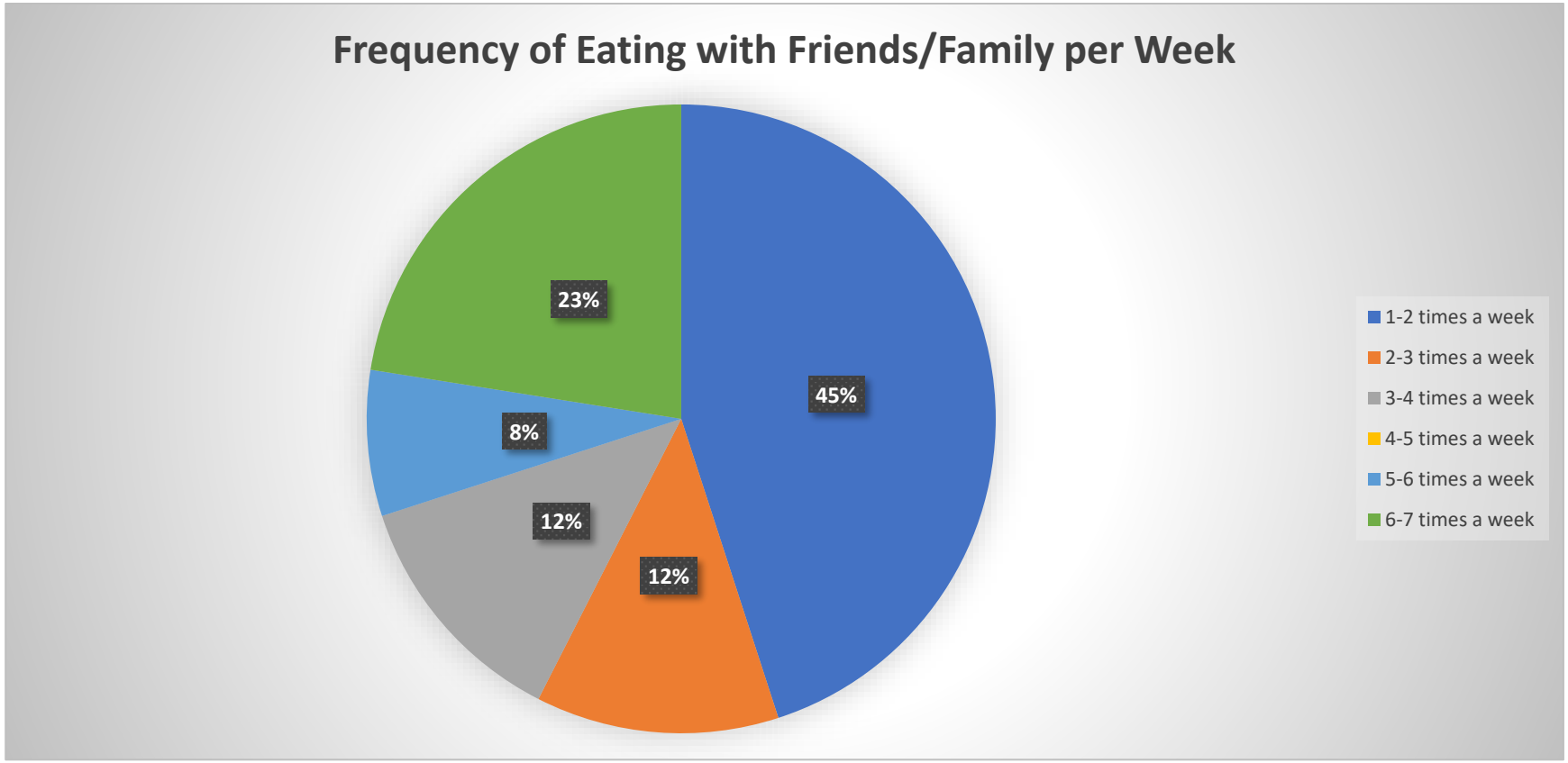

Figure 42: Frequency of Eating with Friends/ Family per Week

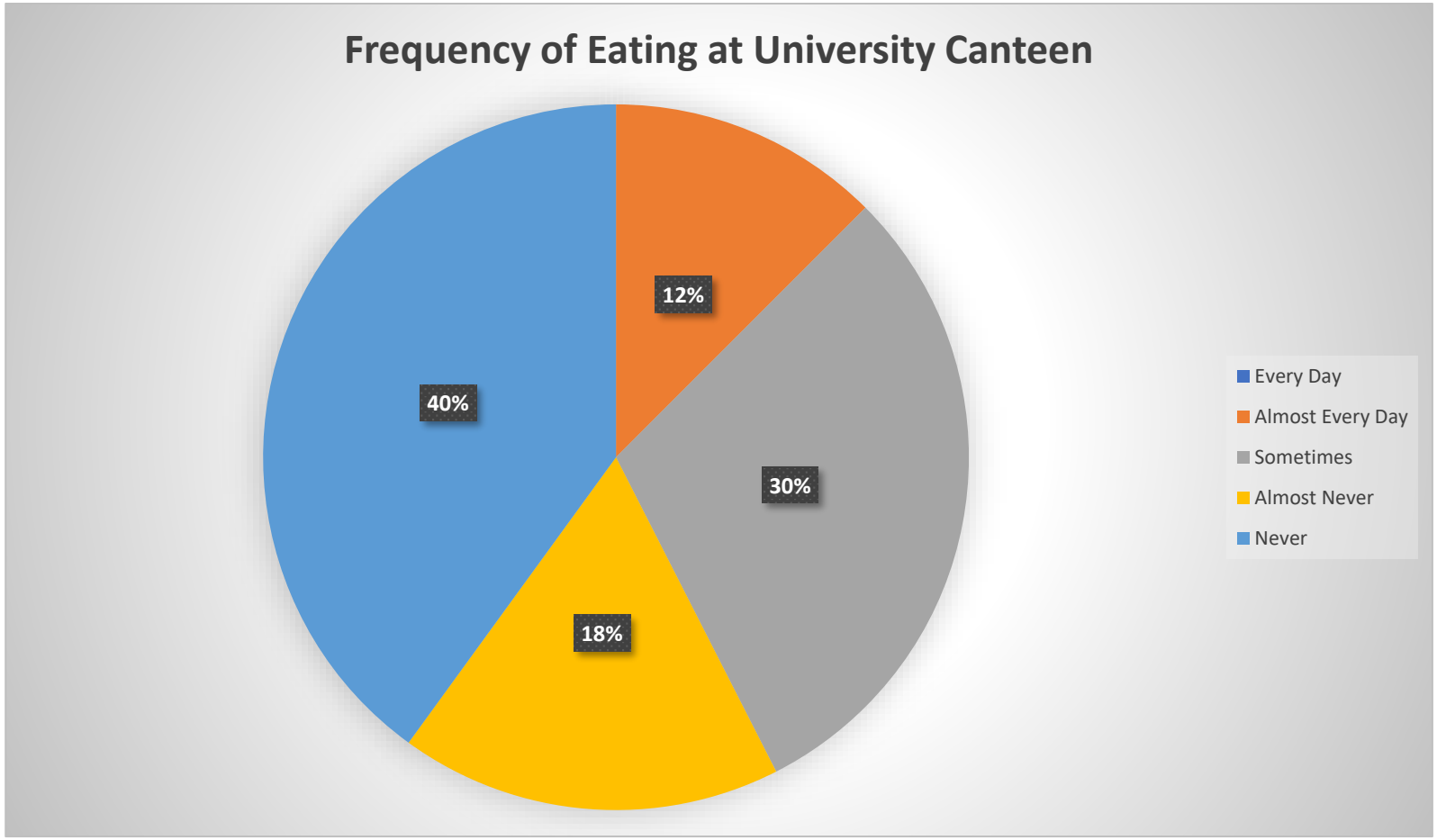

Figure 43: Frequency of Eating at University Canteen

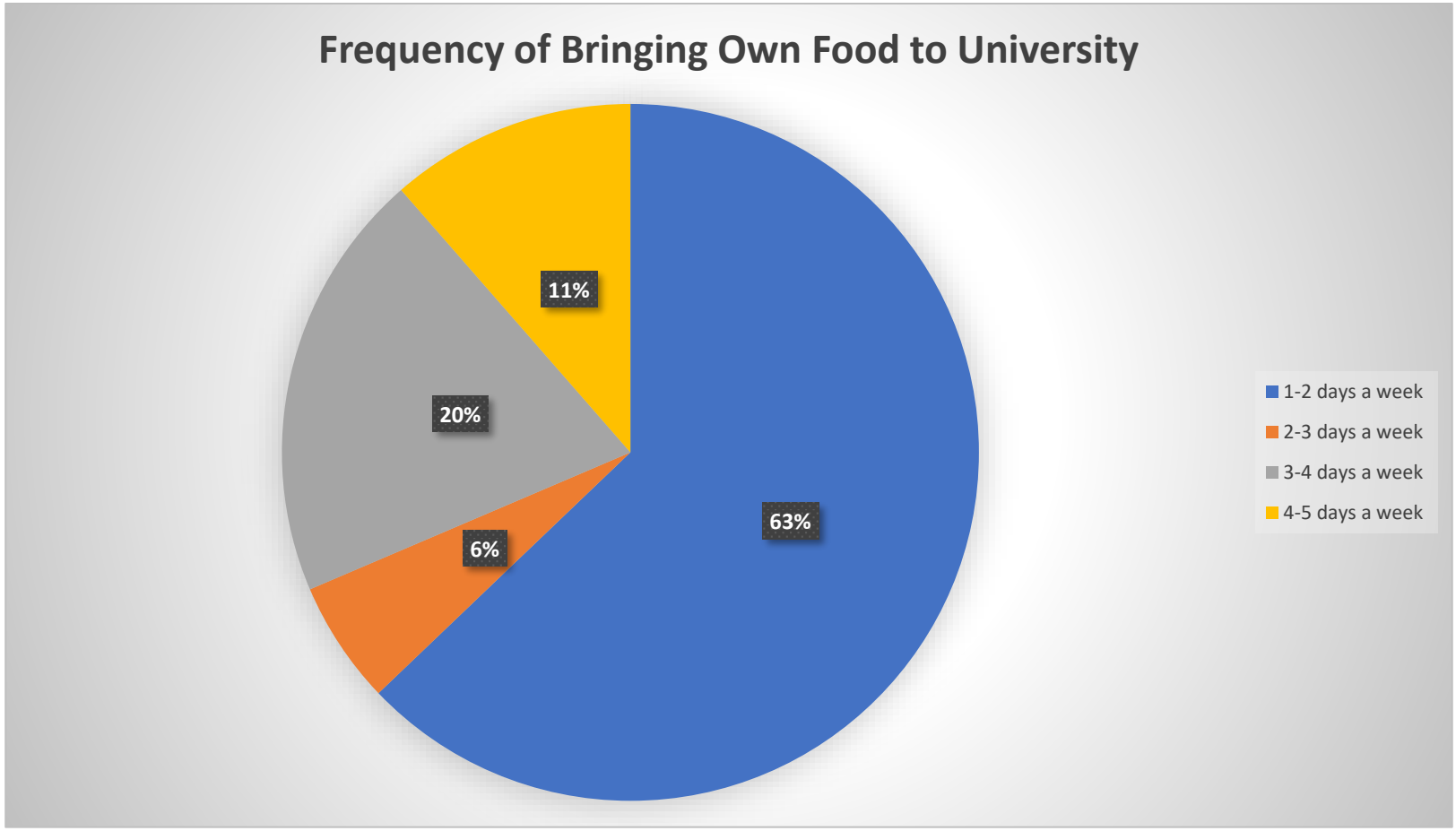

Figure 44: Frequency of Bringing own Food To University

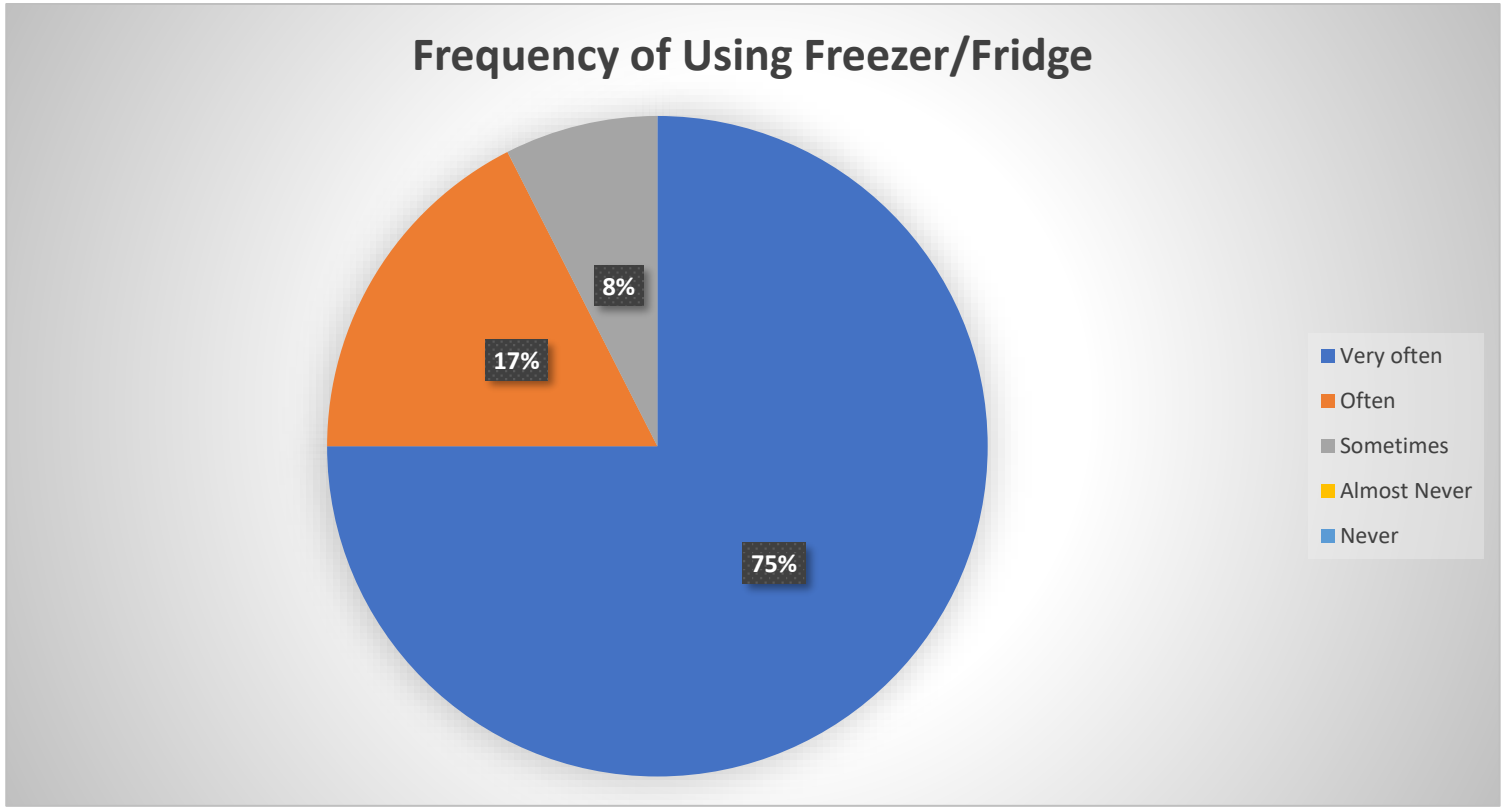

Figure 45: Frequency of Using Freezer/ Fridge

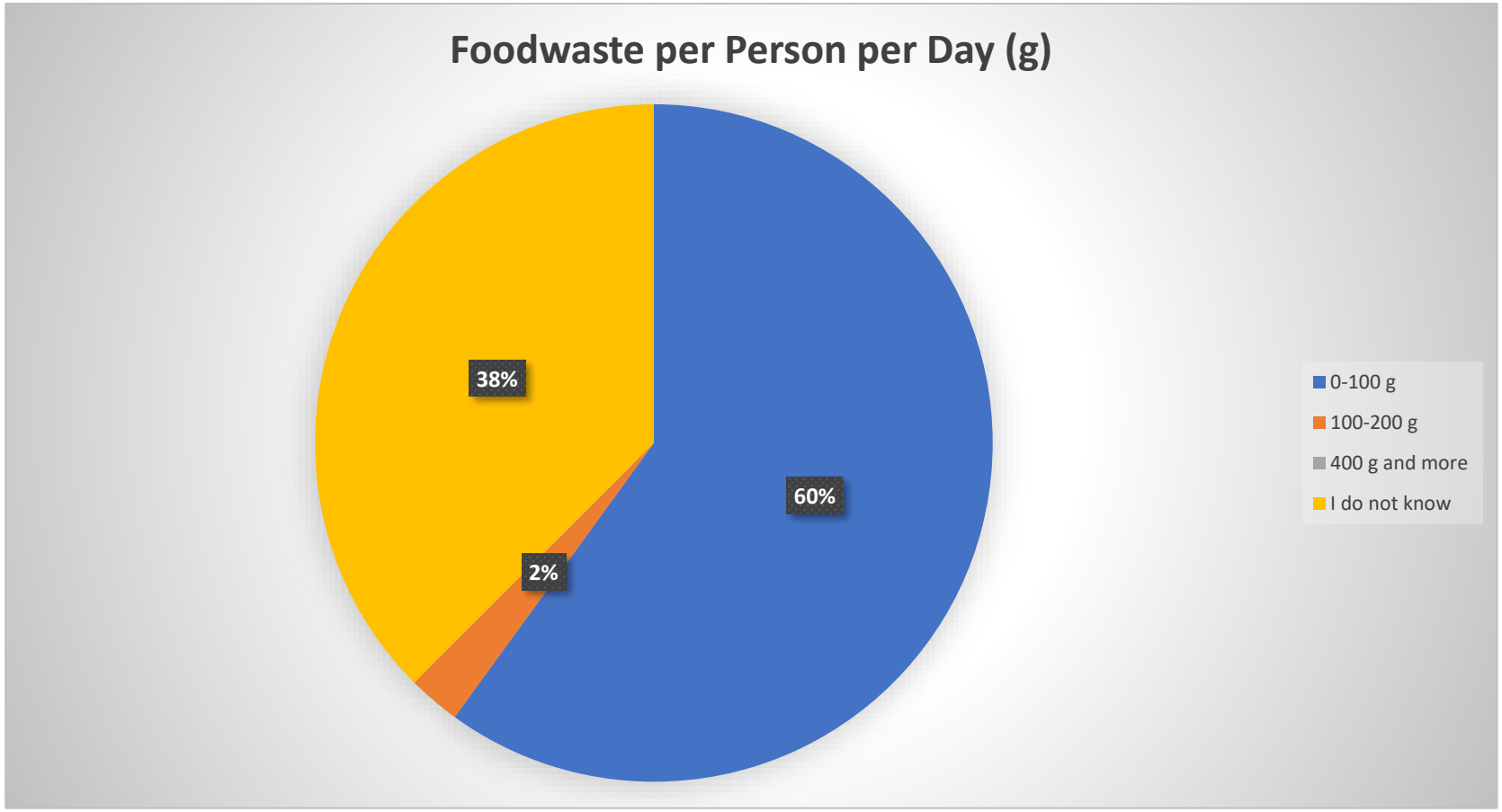

Figure 46: Foodwaste per Person per Day (g)

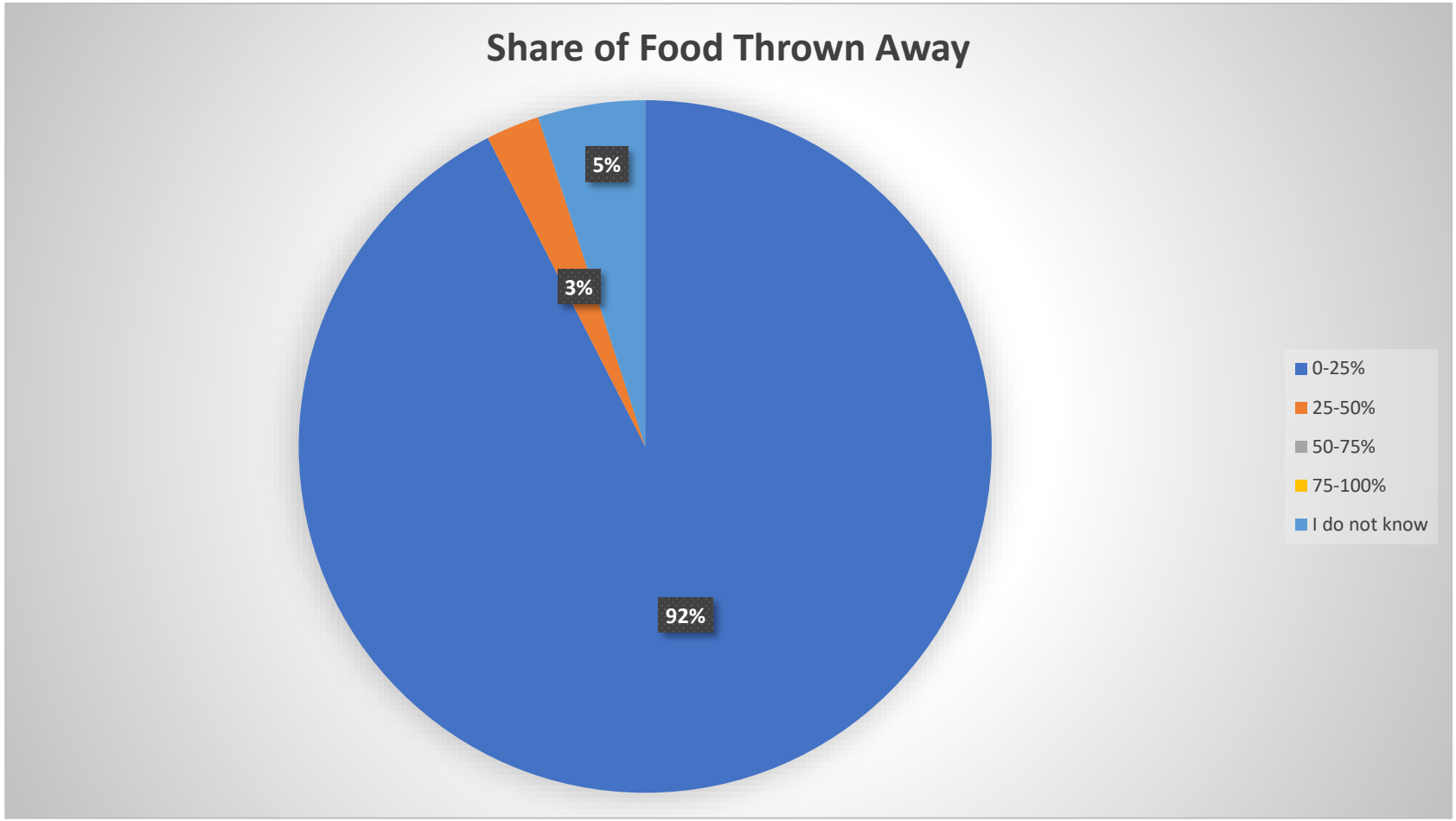

Figure 47: Share of Food Thrown Away

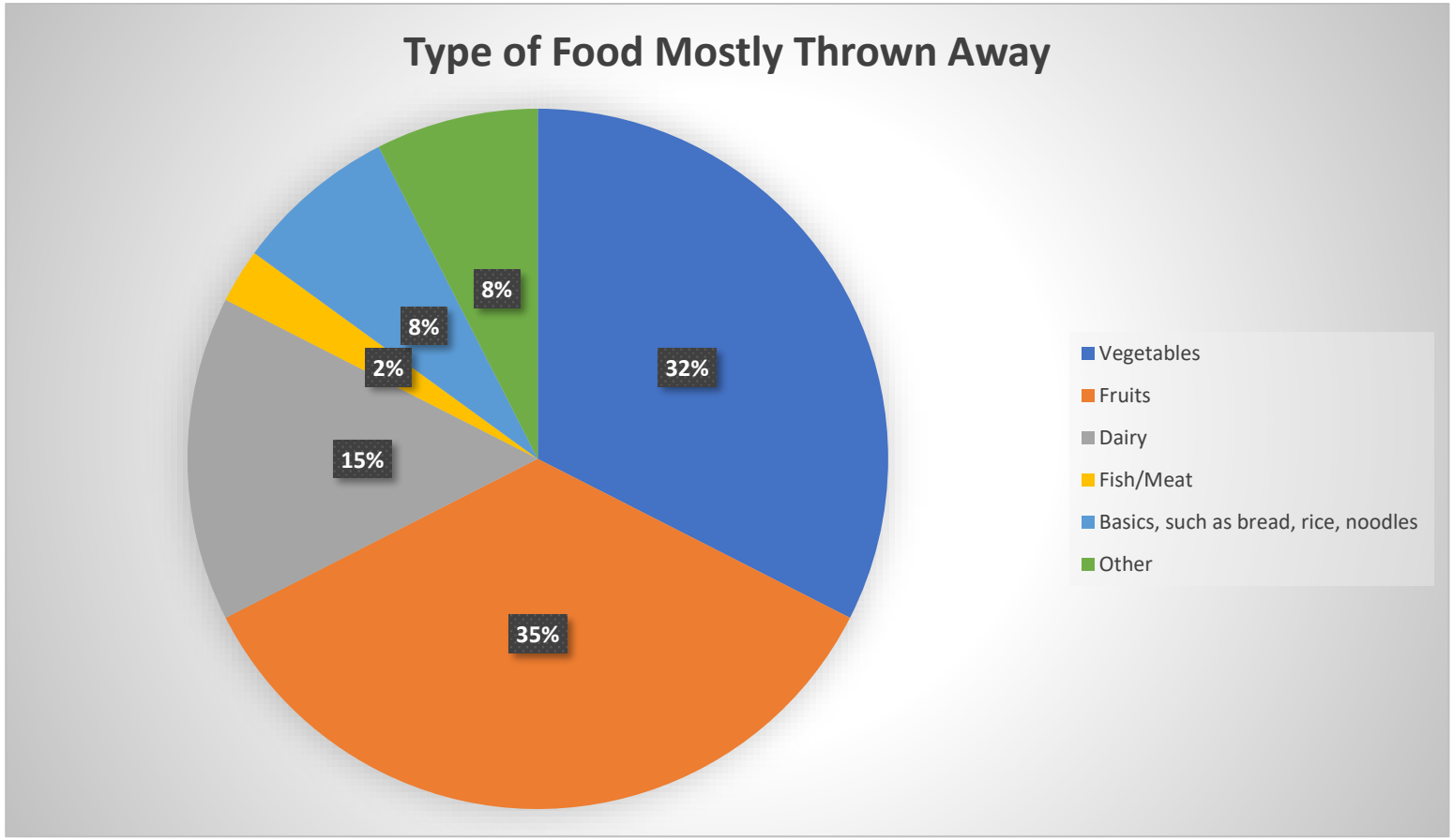

Figure 48: type of Food Mostly Thrown Away

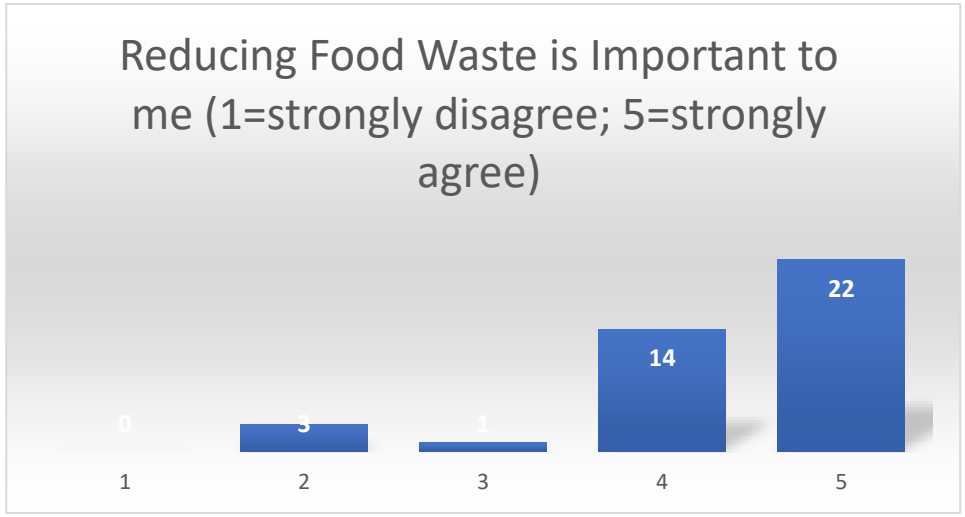

Figure 49: Reducing Food Waste is important to me

Figure 50: I can find enough information on how to reduce food waste

Figure 51: I waste food because of bad planning

Figure 52: That Foodwaste is a problem is new to me

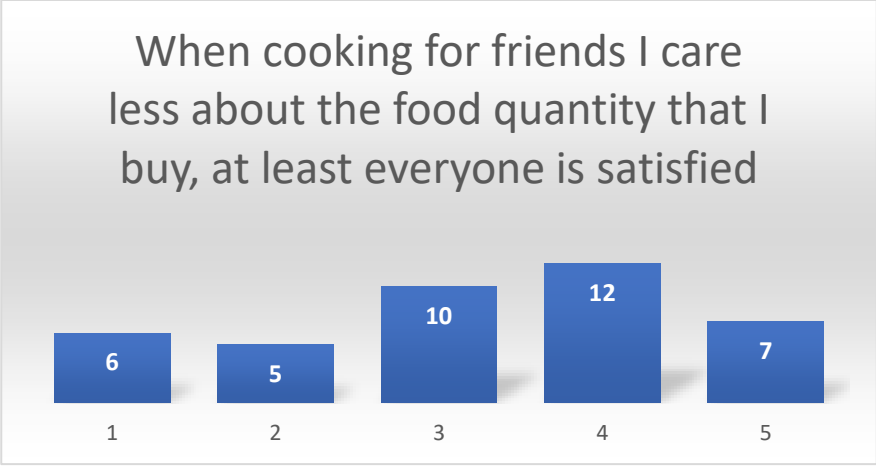

Figure 53: When cooking for friends, I care less about the food quantity that I buy at least everyone is satisfied

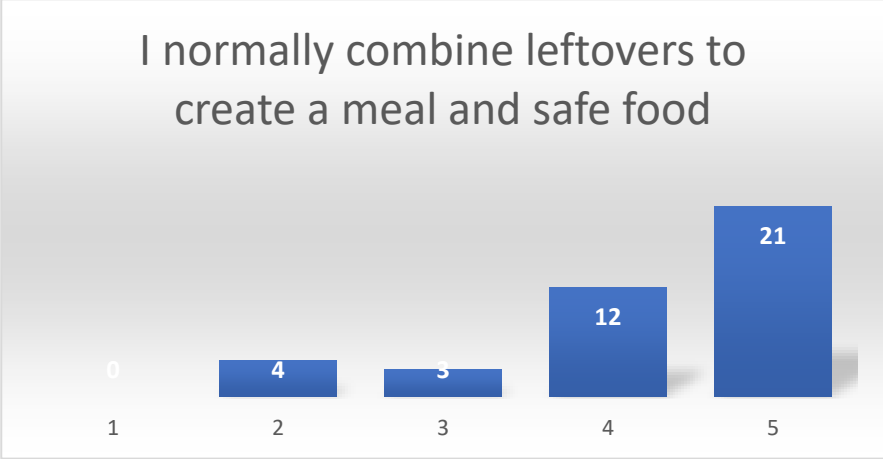

Figure 54: I normally combine leftovers to create a meal and safe food

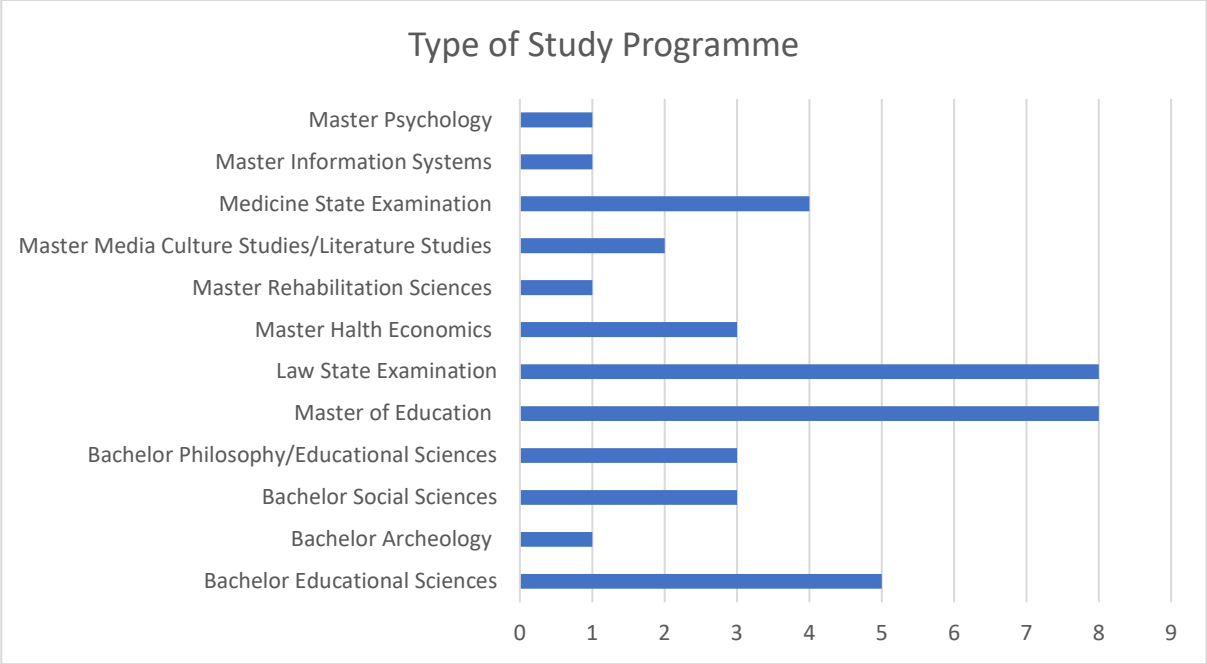

Figure 55: Type of Study program

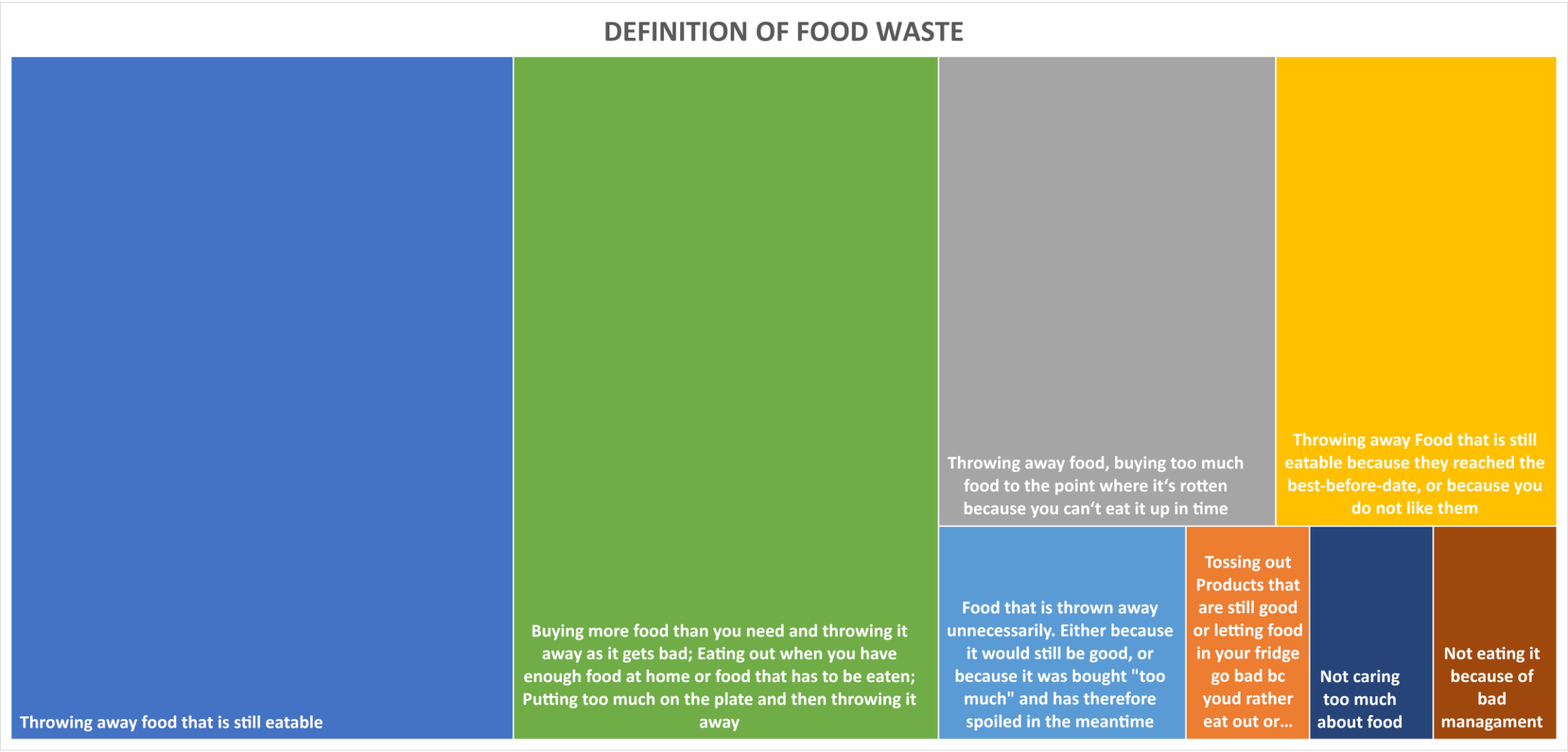

Figure 56: Definition of Food Waste

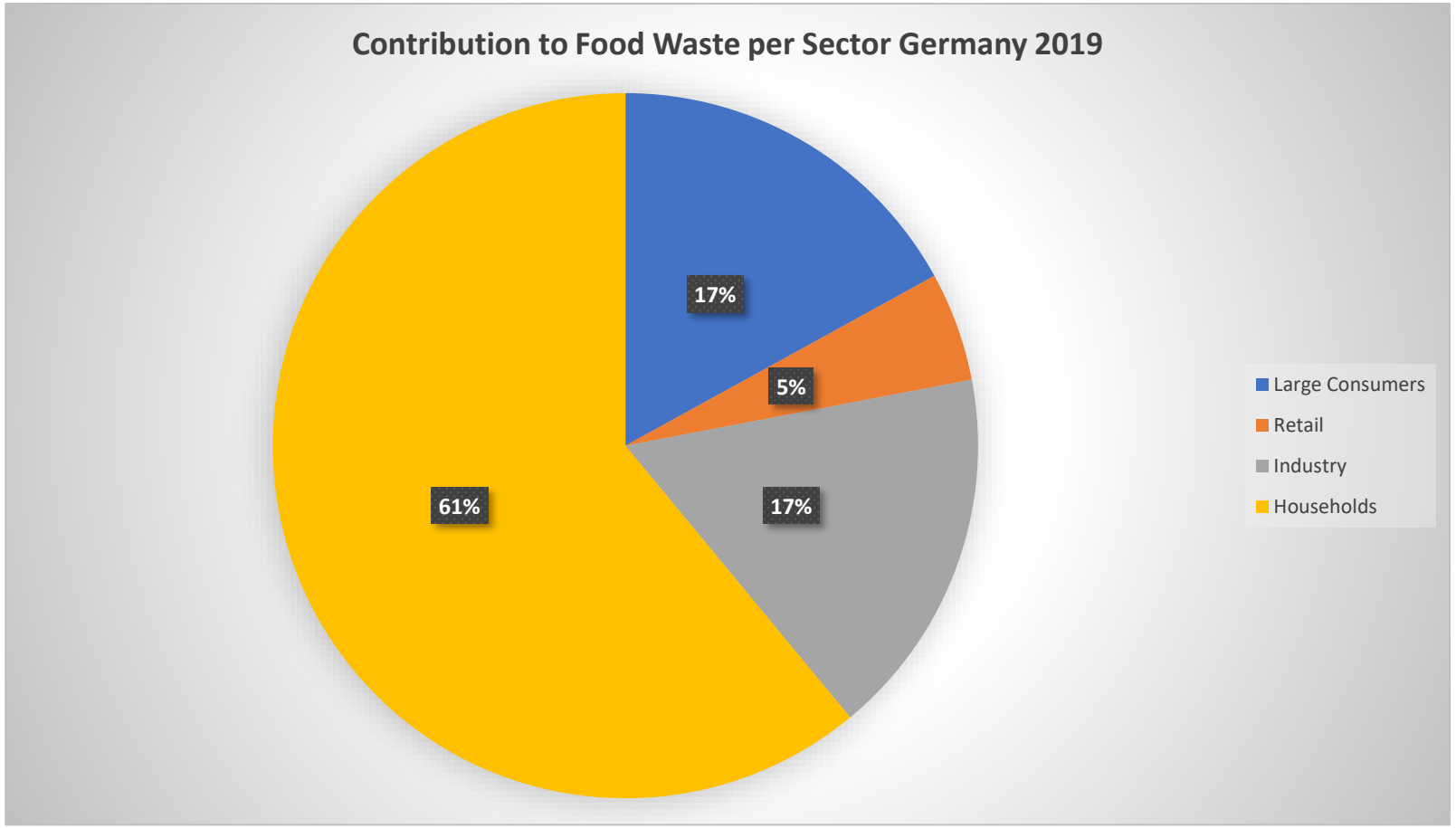

Figure 57: Contribution to Food Waste Per Sector Germany 2019 (Retrieved from: Vowell, 2019)

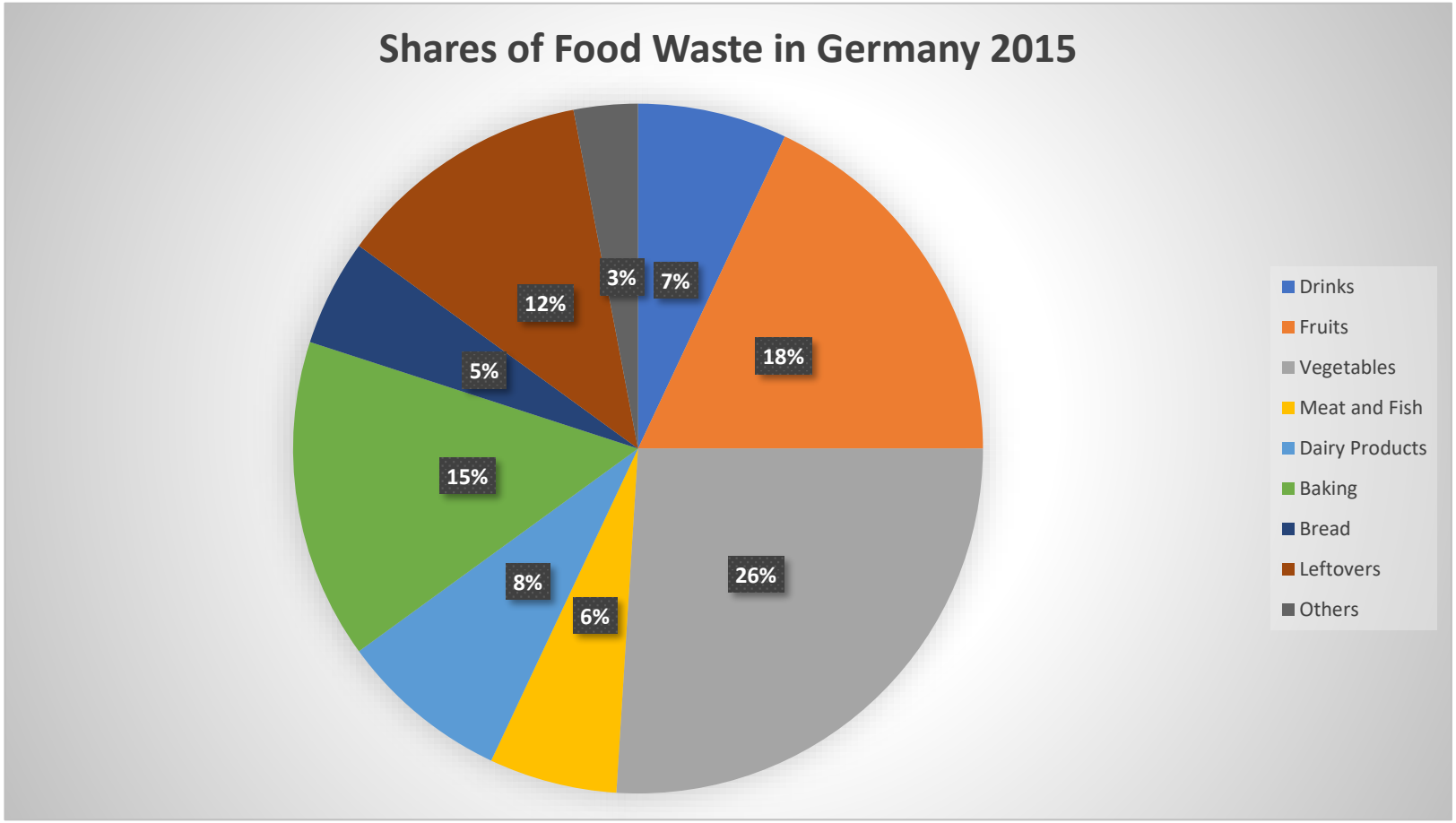

Figure 58: Shares of Food Waste in Germany 2015 (Rerieved from: Vowell, 2019)

Appendix C

Degree of Centrality

Waste Prevention

Attribute	Number of connections	Total Number of Attributes	Sum of All Connections from all Attributes	Centrality
Food Council Cologne	1	14	18	0,78
Food Sharing	1			0,78
Supermarkets and Businesses	2			1,56
Hello Fresh	1			0,78
Food Waste Initiatives	1			0,78
Students	3			2,33
Government	2			1,56
Charitable Institutions such as Food Banks	1			0,78
Café Suedlicht	1			0,78
University Canteen	3			2,33
Food Industry and Food Trade	1			0,78
Everyone	1			0,78
Sum	18			
Average				1,17

Figure 59: Degree of Centrality Action Situation Food Waste Prevention

Waste Disposal

Attribute	Number of Connections	Total Number of Attributes	Sum of All Connections from all Attributes	Centrality
Cologne Citizens	3	7	10	2,1
Students	4			2,80
Government	1			0,70
General Garbage Collection	2			1,40
Sum	10			
Average				1,75

Figure 60: Degree of Centrality Action Situation Food Waste Disposal

Waste Treatment

Attribute	Number of Connections	Total Number of Attributes	Sum of All Connections from all Attributes	Centrality
Local Garbage Collection	2	25	33	1,52
Café Suedlicht	2			1,52
Foodsharing	3			2,27
Bakeries	3			2,27
University Canteen	3			2,27
Supermarkets	2			1,52
Food Bank	6			4,55
Food Council Cologne	3			2,27
Alnatura	3			2,27
Social Democrats	1			0,76
Rewe and Penny	2			1,52
Businesses	1			0,76
Customers	1			0,76
People	1			0,76
Sum	33			
Average				1,79

Figure 61: Degree of Centrailty Action Situation Food Waste Treatment

Sustainability Understanding				
Attribute	**Number of Connections**	**Total Number of Attributes**	**Sum of All Connections from all Attributes**	**Centrality**
Government	6	7	10	4,2
People	1			0,70
Students	1			0,70
University Canteen	1			0,70
Food Council Cologne	1			0,70
Sum	10			
Average				1,40

Figure 62: Degree of Centrality Action Situation Sustainability Understanding

Best-Before Date				
Attribute	**Number of Connections**	**Total Number of Attributes**	**Sum of All Connections from all Attributes**	**Centrality**
University Canteen	3	8	11	2,18
Food Bank	1			0,73
Government	2			1,45
Producers	1			0,73
Too Good To Go	1			0,73
People	1			0,73
Alnatura	2			1,45
Sum	11			
Average				1,14

Figure 63: Degree of Centrality Action Situation Best-Before Date

Institutional Dependency Rate (IDR)	
Waste Prevention	0,07
Waste Disposal	0,22
Waste Treatment	0,04
Sustainability Understanding	0,16
Best-Before Date	0,14

Figure 64: Institutional Dependency (IDR) per Action Situation

Conformance Index			
Action Situation	**# of Links of Conditions to Objects**	**# of Conditions**	**Conformance Index**
Waste Prevention	23	23	1,00
Waste Disposal	12	11	1,09
Waste Treatment	35	35	1,00
Sustainability Understanding	11	11	1,00
Best-Before Date	12	12	1,00

Figure 65: Conformance Index per Action Situation

Waste Prevention				
# of Norms	**# of Rules**	**# of Strategies**	**# of Expectations**	**Total # of Institutions**
4	0	7	15	27
0,15	0	0,26	0,56	**Ratio**

Figure 66: Network Ratio Action Situation Waste Prevention

Waste Disposal				
# of Norms	# of Rules	# of Strategies	Total # of Institutions	Total # of Institutions
0	0	12	0	12
0,00	0,00	1,00	0,00	Ratio

Figure 67: Network Ratio Action Situation Waste Disposal

Waste Treatment				
# of Norms	# of Rules	# of Strategies	# of Expectations	Total # of Institutions
4	7	15	10	36
0,11	0,19	0,42	0,28	Ratio

Figure 68: Network Ratio Action Situation Waste Treatment

Sustainability Understanding				
# of Norms	# of Rules	# of Strategies	# of Expectations	Total # of Institutions
0	0	1	10	11
0,00	0,00	0,09	0,91	Ratio

Figure 69: Network Ratio Action Situation Sustainability Understanding

Best-Before Date				
# of Norms	# of Rules	# of Strategies	# of Expectations	Total # of Institutions
1	0	5	7	13
0,08	0,00	0,38	0,54	Ratio

Figure 70: Network Ratio Action Situation Best-Before Date