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Understanding factors related to food waste in Swedish primary schools

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Abstract

Production and consumption of food have several environmental impacts, regardless of the type of food production. However, food production can have a particularly large impact on the environment, as it often causes pollution and spreads harmful contaminants in nature. Additionally, a lot of food is produced today, which leads to a significant amount being wasted and contributing to environmental problems. In Sweden, approximately 1.3 million meals are served daily in schools. There is a need to study food waste, its causes, amounts, and what can be done to reduce it.

Therefore, the factors affecting food waste in school cafeterias must be known, and different methods can be used, such as interviews and surveys. By investigating the causes of food waste, problem areas can be identified, and solutions can be found to reduce food waste. The study underscores the importance of studying food waste and increasing awareness to promote sustainability. It is an important task that requires cooperation and commitment from all involved parties and can have positive effects on both the environment and society as a whole.

In this study, several factors contributing to the problem were identified, and suggestions for measures to reduce waste were presented. One of the major challenges is the lack of awareness and education about food waste among both students and teachers. The results indicated that the topic is rarely discussed in the classroom, resulting in insufficient knowledge about how to reduce waste. Another important factor is students' dissatisfaction with the taste of the food, which leads to incomplete meals or leftovers on their plates. To address students' needs, improvements in menu planning are proposed, including collaboration with professional chefs and dieticians to offer a diverse menu that can reduce waste. A short lunchtime and the pressure to return to classes on time also contribute to food waste. To mitigate waste, measures such as increasing awareness through classroom discussions and information campaigns are suggested. Involving students in menu planning and ensuring they have sufficient time to eat can also contribute to waste reduction. Education on nutrition, healthy eating habits, and portion control is emphasized as crucial.

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1 Introduction

When growing vegetables, large amounts of nutrients such as nitrogen and phosphorus are used up, which can lead to an excess of nutrients. This can lead to harmful algal blooms and oxygen depletion in the ocean, leading to dead sea floor and species extinction. Animal products in general also have an environmental impact that can be greater than fruits and vegetables, because they require more resources to produce (WWF, 2019).

The issue of food waste is closely related to the emissions associated with food production. The EU Parliament (2011) estimated that for every kilogram of food produced, 4.5 kilograms of carbon dioxide are released into the atmosphere. When food is wasted, all the resources used in its production, including land, water, energy, and fertilizers, are essentially wasted as well. This means that the emissions resulting from the production of that wasted food are also unnecessary and contribute to environmental harm. In 2014, 43,000 tons of food were thrown away in Swedish schools and preschools, with 52% of this waste being edible (Swedish Environmental Protection Agency, 2013).

Reducing food waste would have positive effects on the environment and contribute to more sustainable development. It involves minimizing environmental impact, preserving biodiversity, reducing resource depletion, and improving soil health. Practices such as organic farming, crop rotation, and resource conservation are key to achieving these goals. By adopting sustainable practices, we can protect the environment, preserve natural resources, and support long-term ecological, social, and economic well-being. This would reduce eutrophication and decrease the amount of harmful contaminants in the environment, while also creating a richer plant and animal life and a more varied agricultural landscape (Swedish Environmental Protection Agency, 2013).

Food waste is a complex and challenging topic to study and measure because of the lack of consensus on a definition. Different definitions have been utilized alternately, including kitchen waste, biowaste, food waste, and food loss. The lack of a standardized definition makes it difficult to compare data and develop effective policies and strategies to address the issue (Abdiu, 2019).

According to Abdiu (2019), food waste was defined in 1943 as the spoilage or decay of food products or the utilization of livestock, crops, and livestock-related items in ways that result in relatively minor nutritional value for human consumption. However, in more recent years, the United States Environmental Protection Agency (USEPA) has defined it as the leftover food and waste generated during food preparation from homes, commercial establishments, and institutional settings (Abdiu, 2019). So food waste from residential households, grocery outlets, food service establishments (e.g., bars, restaurants, and staff canteens), and manufacturing facilities' lunchrooms are

encompassed. Additionally, pre-production food waste that arises during food processing and packaging is classified as food loss.

The lunches served in preschools should give all children (6-14 years old) the opportunity to have sustainable eating habits, which is important for good public health. To encourage and support this work, the Swedish Food Agency has developed a model with six areas, which are nutritious, safe, good, pleasant, integrated, and sustainable (Swedish Food Agency, 2013). Good and pleasant means that the children should get good food in a stimulating environment, sustainable means that the food served should consider the environment and climate, and integrated means that the children should have a positive attitude towards food through the pedagogues. Educators play a crucial role in encouraging children to try new foods by stimulating conversations about food and serving as adult role models. In 2011, it also became a legal requirement that the food served in Preschools and primary schools must be nutritious (Swedish Food Agency, 2013).

According to Högström (2017), the food served in the nursery school is covered by the hygiene regulation, and whoever serves the food must ensure it is safe. Once the food has left the kitchen, it can no longer be kept warm at the +60°C required for hygienic and safety reasons, therefore this food must be discarded after the end of lunch. A longer storage time also causes a deterioration in nutritional value and reduced palatability.

In addition, according to (Pekin, 2019) there are laws, regulations, and technologies that can contribute to reducing food waste, but the behavior and habits of consumers and students are crucial factors. A significant amount of food waste occurs due to plate waste in schools, where students take more food than they can, resulting in significant amounts of food waste. Changing the behavior of students is challenging, but it is a vital factor in reducing food waste. Working on behavior change in students can complement existing laws, regulations, and technologies for reducing food waste.

1.1 Aim

The aim of this thesis is to explore the causes of food waste in primary schools and propose practical solutions to mitigate it. To achieve this goal, a comprehensive investigation will be conducted in a municipality in Stockholm County. The results of this research will provide valuable insights that can be used to develop practical suggestions aimed at reducing food waste within educational institutions and promoting environmentally conscious dietary behaviors.

1.2 Research questions

- 1) Which are the underlying factors behind food waste in primary schools?
- 2) What possible measures are there to reduce food waste in primary schools?

1.3 Limitations

As the study is limited in time, certain constraints will be imposed. Geographically, the research will be focused on a school in Stockholm. This investigation will concentrate solely on food waste that arises during school lunches. The study won't focus on breakfast, snacks, and fruits that can be provided in primary school. The study will not either investigate the waste of milk and water even though they are provided as a meal beverage during lunch. As a result, the study will only consider food that was discarded even though it could have been consumed.

2 Background: An overview of the problem and its causes

2.1 A comprehensive look at food waste in schools

Livsmedelsverket has identified schools as the sector that has reported the most data on food waste. According to their information, the total food waste from kitchens, serving areas, and plates during school lunches in primary and secondary schools amounts to approximately 56 grams per student, excluding beverages. This means that, on average, about one in six portions is discarded (the Swedish Food Agency, 2023).

According to the article "From Old Habits to New Routines—A Case Study of Food Waste Generation and Reduction in Four Swedish Schools," several causes of food waste in schools are discussed (Osowski et al., 2022). One of the main reasons is overproduction and misjudgment of portion sizes, as well as inadequate meal planning. This often results in the production and serving of more food than students actually consume. Additionally, students may have specific dietary restrictions or preferences, such as allergies, diet limitations, or personal taste, which can lead to unfinished portions. Another significant factor is the presence of self-service systems in school cafeterias, allowing students to choose their own foods and quantities. This can result in taking more food than they can eat, resulting in leftover food that is discarded. Insufficient awareness and education among students and staff are also significant contributors. If they are not aware of the consequences of food waste and how to reduce it, they may lack the incentive or knowledge to take initiatives to minimize waste or utilize effective methods for managing food waste (Osowski et al., 2022).

Measuring the amount of food waste is an effective method for reducing food waste in schools and preschools. By periodically weighing food waste, the staff can get a more continuous and detailed picture of how much food is thrown away. This can help identify which dishes are often left uneaten and adjust portions accordingly, which in turn reduces food waste. According to Högström (2017), it is recommended to distinguish between plate waste and serving waste when measuring food waste in order to identify where the largest amount of waste occurs.

Nystedt's study (2018) aimed to investigate how municipal primary schools in two Swedish municipalities worked to reduce food waste. To investigate the topic, an electronic survey was sent out to 21 primary schools that could voluntarily participate in the study. The results showed that the most common measure to reduce food waste was for schools to measure the amount of food waste. Measuring food waste was used as a basis to see if other measures were effective or not. Measuring food waste is important to reduce waste because it gives us concrete and factual information and schools can see how it is progressing and compare it with previous results. As the goal of the work is to reduce food waste, it is important to know if the measures implemented actually lead to reduced food waste. Therefore, measuring food waste is essential to evaluate the

outcome. Without proper measurement, it becomes challenging to assess the effectiveness of the implemented measures.

Experiences from schools that have measured plate waste have shown that it is important to inform students that waste measurement will take place, as they are influenced to throw away less food when aware of the measurement (Nystedt, 2018). Jonsson and Svedlund (2022) point out that people are more likely to act to reduce food waste the more aware they are of the problem. To achieve this goal, the amount of food waste can be demonstrated and students can be actively involved in reducing it. By increasing students' awareness of the problem and involving them in solutions, their enthusiasm and motivation to reduce food waste can be increased.

According to Mattisson (2015), the study in Eskilstuna sought to assess the scope of food waste in school kitchens, and it has been conducted regularly since 2009. During a period of approximately two weeks, plate waste, serving waste, and preparation waste are measured. Only the cooked food is weighed, while liquid waste is not included. The results are recorded by each kitchen and collected by a nutrition consultant for compilation. It is revealed that schools themselves determine the duration of waste measurement, but it typically spans a two-week period. Students are usually unaware of the measurements being conducted. According to the results of the study, the average total food waste in the participating schools ranges from 17.5% to 19.5%.

Interestingly, one of the schools in Eskilstuna managed to reduce its food waste by up to 9%. This demonstrates the possibility of significantly reducing food waste through awareness, analysis of the results, and implemented measures. The study emphasizes the importance of collecting and analyzing data on food waste in schools to identify the types of food and meals that are most frequently wasted. This information can then be utilized to implement measures that reduce waste and promote more sustainable management of food resources in schools (Mattisson, 2015)

By highlighting the findings of these studies and working towards reducing food waste, schools can contribute to reducing overall environmental impact, saving resources, and educating students about the importance of waste reduction and being more mindful of their food consumption.

2.2 The underlying factors behind food waste

Plate waste is a problem that many municipalities struggle with as it leads to both economic and environmental consequences. A large number of food portions are thrown away every day due to various factors, including overproduction and inadequate meal planning. Additionally, it is a challenge to change students' behaviors to reduce food waste (Pekin, 2019).

One of the main causes of food waste is overproduction. Many times, more food is cooked than is actually needed, leading to a large portion of the food being discarded. Inadequate meal planning can also lead to surplus food being thrown away (Pekin, 2019). Several factors can also affect the demand for food, leading to food being left over and eventually discarded. For example, students may become ill and not attend school, or there may be other reasons why fewer students than usual eat in the school cafeteria.

Jonsson and Svedlund (2022) conducted a study on the factors that contribute to food waste in school cafeterias, it was found that the ambiance, aesthetics, smell, and the number of adults present in the cafeteria are some of the characteristics that impact food waste. In their report, the authors refer to a proposal from the Swedish Food Agency that suggests that a pleasant and comfortable dining environment can increase the likelihood of students consuming their food. The results of this study indicate that ambiance and comfort are two factors that influence the occurrence of food waste in schools.

The level of comfort that students experience in the cafeteria can be influenced by various external factors in the dining environment, such as the smell of the room, aesthetic impressions, noise levels, or the number of adults present in the cafeteria. For instance, a lack of support from adults can lead to the cafeteria being perceived as more chaotic or insecure. The sense of security in the cafeteria can also be affected by disruptive situations and high noise levels. To promote a sense of security in schools, the presence of adults can be of significant importance. Therefore, creating a comfortable and pleasant dining environment in schools can help to reduce food waste and promote healthy eating habits among students (Jonsson & Svedlund, 2022).

It is important to identify and understand the causes of waste in order to take appropriate measures to reduce it. By improving planning, management, and monitoring of resources, increasing awareness and education of personnel, and utilizing innovative techniques and technologies, waste can be reduced, thus minimizing negative consequences for both the environment and the economy.

People's self-identity and moral values influence their behaviors in relation to the environment, meaning that a person perceives themselves as an integral part of nature and sees the environment as a central aspect of their identity. When the environment becomes a significant part of one's self-identity, their commitment and motivation to act in its protection and preservation also increase. When a person feels a strong moral obligation to act for the environment, they are driven by inner commitment and a sense of responsibility. This morally driven motivation can be stronger and more enduring than other motivational factors because it involves living in accordance with one's own values and ethical principles. By promoting a strong environmentally related self-identity and emphasizing moral values, motivation and commitment to pro-environmental behaviors can be enhanced among individuals and communities (Van der Werff et al., 2013). It is important to develop an environmentally oriented identity

among students and create a sense of responsibility and obligation. This can be achieved by implementing campaigns to raise awareness about the consequences of food waste and promoting a strong environmentally oriented identity among students. This can be done by integrating environmental subjects and values into school education and involving students in environmental activities and projects. It can be effective to have open discussions and reflections on these moral issues in the classroom.

Investigating why people behave in ways that contribute to food waste is crucial to effectively address the issue. The theory of value-belief-norm (VBN), developed by (Stern, 2000), can be useful in understanding these behaviors. According to the VBN theory, behaviors that impact the environment are strongly linked to a person's values, attitudes, knowledge, and norms.

Stern emphasizes that behavior change is a central issue in promoting environmentally friendly actions and reducing negative environmental effects. To achieve such change, he suggests a combination of strategies including knowledge dissemination, norm change, and the creation of environmentally friendly incentives and infrastructure (Stern, 2000). By influencing attitudes and increasing awareness of the negative consequences of food waste, one can contribute to behavior change. Knowledge is another crucial factor, and providing information about the extent, causes, and solutions to food waste can raise awareness and promote more sustainable behaviors. For example, education on food storage, shopping habits, and the consequences of food waste can empower individuals to make more conscious decisions and reduce waste (Ekman, 2019). Therefore, understanding the factors that influence behavior and employing strategies that target these factors can increase the likelihood of people adopting more environmentally friendly behaviors and thus reduce negative environmental impacts.

The purpose of using the VBN theory is to identify factors that promote behaviors that lead to reduced food waste. However, even if a person has a positive attitude and interest in acting environmentally friendly and reducing their food waste, external factors can prevent them from maintaining a sustainable lifestyle or behavior. There is a growing global awareness of the environment, but this does not necessarily mean that people will automatically reduce their food waste. Interventions adapted to specific situations are required to encourage people to change their behavior. Old habits may need to be broken, and different efforts may be needed to help people overcome obstacles and create new habits (Ekman, 2019).

It is important to understand the external factors that can hinder people from reducing their food waste in order to develop effective interventions and encourage sustainable behavior. To help a person change their habits, one must understand the specific factors that contribute to those habits and then use interventions tailored to those factors. This may require an individualized and adaptable strategy to be most effective (Ekman, 2019).

VBN theory can be applied to address the issue of food waste in preschools by identifying specific factors that contribute to children not finishing their meals and developing interventions that promote sustainable food consumption practices. For example, one factor could be that the children do not like the taste or texture of the food. An intervention could be to offer different types of food or prepare the food in different ways to cater to individual taste preferences. Another factor could be that the children are not able to sit still and focus on eating at the table. An intervention could be to create a calm and safe atmosphere at the table, with quiet music and positive reinforcement when the children eat well.

With the VBN theory, underlying causes of food waste in schools can be identified by analyzing the thoughts and actions of students, teachers, and staff in relation to the problem. To reduce food waste in schools, it may be necessary to work on changing the values, beliefs, and norms of students, teachers, and staff. This could include creating a culture where resources and environmental conservation are valued and offering education and awareness on how to reduce waste.

3 Methods

The research methodology employed in the study consisted of multiple approaches. Firstly, interviews were conducted with primary school students. These interviews aimed to gather insights and perspectives from the participants. Additionally, data collection from primary school students was accomplished by conducting an online survey. Furthermore, a web-based literature search was conducted using various databases. This literature search aimed to gather relevant information and existing research findings related to the research topic.

By employing a combination of interviews and surveys with primary school students, and a literature search, the study aimed to obtain comprehensive and diverse data sources. This multi-faceted approach allowed for a more comprehensive understanding of the research subject and provided a well-rounded analysis of the research question.

The chosen primary school is called Spånga Grundskola and is located at Adolf Rudbecks väg 21 in Spånga. It is intended for grades 7-9 with seven classes in grade 7 and six classes in grades 8 and 9, with a total of 490 students. The school provides breakfast at a nominal cost every morning and lunch each day. Restaurant Grytan prepares 2000 portions daily, and on two occasions each week, exclusively vegetarian food is served to conserve the earth's resources (Stockholms stad, 2022).

3.1 Interviews

It was important to get students' views on the food waste situation. Therefore, interviews were conducted with four students from primary school. By interviewing these students who handle and dispose of food themselves, a more comprehensive understanding of their perspectives and experiences could be achieved.

The interview questions were created by drawing from prior studies on food waste in school kitchens. The questions were modified to address the research objectives of the study. The interviews were organized and held either in person or via the online platform Zoom. Furthermore, the interviewees were given the option to choose the interview's timing to minimize any interference with their duties. Finally, the interview duration ranged from 15 to 30 minutes, based on the interviewee's enthusiasm and participation level.

The interviewees' identities were kept confidential. The interviews were recorded digitally only after obtaining the respondent's permission, and the recording was used to transcribe the interviews after completion. To scrutinize the data, the recordings and transcriptions were examined further after the interviews were completed to recognize any resemblances or differences among the various interviews, thus enabling the results to be classified.

3.2 Surveys

To gather data from primary school students, an internet-based survey was conducted. Surveys are a common method for collecting data from a large group of people in an efficient way. By using internet-based surveys, a wider audience can be reached and a larger amount of data can be obtained in a shorter amount of time compared to personal interviews or paper surveys.

To ensure high participation in the survey, the questionnaire consisted of short and easy-to-answer questions. The questions had predetermined answer options to reduce the risk of respondents dropping out of the survey due to exhaustion or lack of motivation. Additionally, it becomes easier to process and analyze the data when the answers are structured in a predetermined way.

The survey questions focused on identifying the causes of food waste and exploring potential strategies for minimizing it. Respondents were encouraged to reflect on their own attitudes toward sustainable development and food waste. By investigating these questions, a better understanding can be gained of the factors that contribute to food waste in primary schools, as well as identifying strategies that can be used to reduce it.

4 Results

This section will present the results obtained from four interviews and a survey with 77 participants. The interviews and surveys aimed to identify the underlying factors behind food waste and potential measures that can be implemented to reduce it in primary schools.

Below, are the most crucial answers present obtained from the interviews conducted with primary school students. These responses provide valuable insights into their perspectives.

A1: "Teachers should educate students about food waste, especially considering the provision of free school lunches in Sweden, which can lead to its undervaluation."
(Student)

A2: "Many students do not appreciate the privilege of having free lunch, so it can be beneficial to help students understand what happens in other countries compared to Sweden."
(Student)

A3: "It could be beneficial to show students what is happening in other countries, particularly in poor countries where there is famine and children barely receive one meal daily."
(Student)

A4: "Food waste can be reduced by getting students to understand that it is the staff who have worked all day to serve us food, and in the end, it is being thrown away which shows ingratitude towards the staff."
(Student)

A5: "I believe that we should start paying for our meals or have a weekly day where children bring their packed lunch to understand how difficult it is to prepare meals."
(Student)

A6: "Older students throw away too much food. My friends and I don't throw away as much food. Maybe because our teacher sometimes sits with us while their teacher doesn't."
(Student)

A7: "I sometimes eat quickly because other classes are going to eat"
(Student)

A8: "I throw the food away when it doesn't taste good because I can't eat it"
(Student)

A9: "I don't eat vegetables and fruits because there are already at home, they are constantly in every place"
(Student)

A10: "It's boring to eat vegetables and fruits, meatballs and French fries are better"
(Student)

The diagram below (Figure 1) provides a visual representation of whether teachers discuss food waste in the classroom or not based on survey responses. The majority of

students answered "No, never," indicating a lack of knowledge about the topic among students. This emphasizes the need to increase awareness and educate students about food waste.

Do your teachers often talk about food waste in class?

76 responses

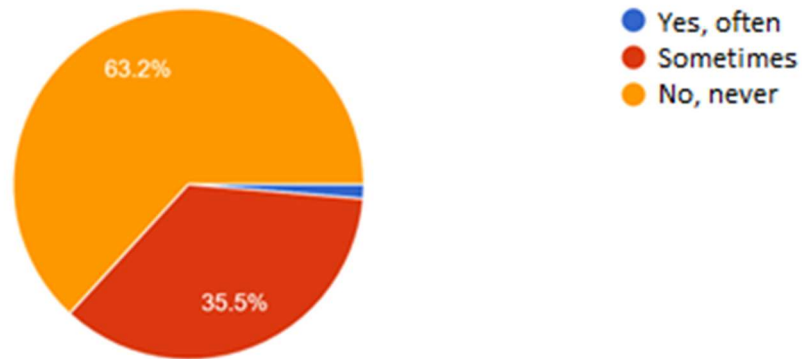


Figure 1: The pie chart provides an overview of how often teachers engage in conversations about food waste according to the survey respondents.

Source: The pie chart was created using data from a survey conducted by the authors.

The graph below (Figure 2) represents the responses to the question about factors contributing to food waste in schools. Participants were provided with multiple options, and the majority of students indicated that the food not tasting good was a significant factor. Additionally, several students mentioned that the large portion sizes, limited variety of dishes, and short lunch breaks also contributed to food waste. These findings highlight the importance of addressing these factors to minimize food waste.

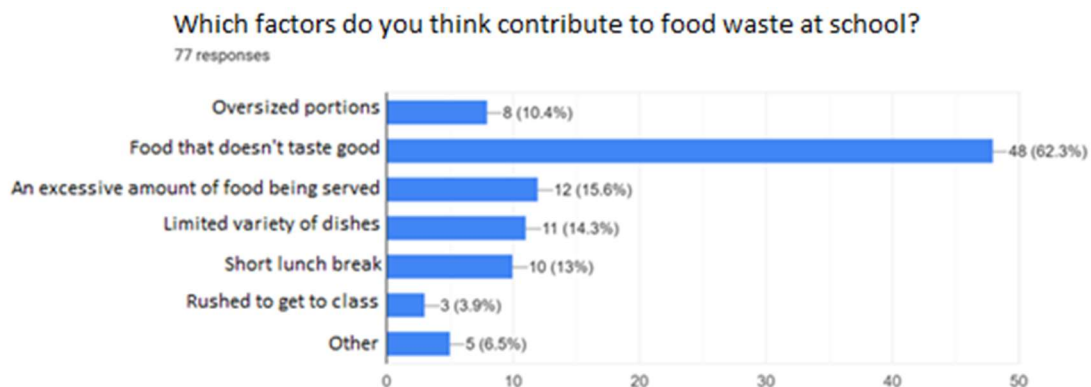


Figure 2: The graph represents responses to the question about factors contributing to food waste at school. Participants were given multiple options, and the graph visually displays the distribution of their responses.

Source: The graph was created using data from a survey conducted by the authors.

The pie chart below (Figure 3) provides insights into the different perspectives on how well the school meals match the respondents' needs. The answer options were "Yes, always", "No, never" and "Sometimes". More than 46% of respondents answered "No, never." It indicates that a significant percentage of respondents feel that school food

does not consistently meet their needs, that is, students do not like the food served. This finding underscores the importance of involving students in the menu planning process and considering their input when preparing meals. By actively engaging students and taking into account their preferences, schools can work to provide meals that are more appealing and satisfying to students.

Do you think the food served at school suits you and your needs?

77 responses

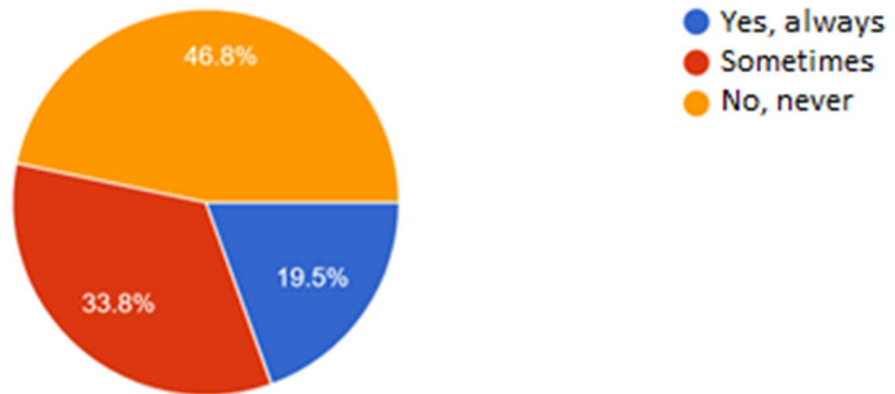


Figure 3: This pie chart provides insights into the varying perspectives on how well the school food aligns with the needs of the respondents.

Source: The pie chart was created using data from a survey conducted by the authors.

The diagram below (Figure 4) presents the answers to the question about proposals to reduce food waste in schools. Students were given several options, and the majority of students indicated that it would be beneficial to diversify the variety of dishes. This is because not all students like the same type of food, and offering a variety of meals would be more appealing to them. In addition, many students also suggested giving the option to allow for seconds if desired and to extend the lunch break. These results underscore the importance of offering a wide variety of food options in school cafeterias to accommodate different tastes and preferences. Allowing students to take more food if they want and providing longer lunch breaks can also help reduce food waste by ensuring that students have enough time to enjoy their meals.

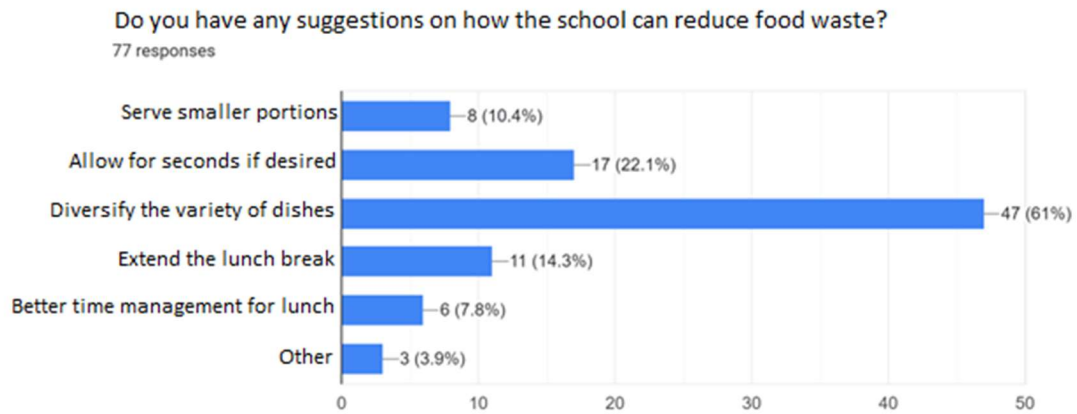


Figure 4: The graph shows responses to the question regarding suggestions for reducing food waste at school. Participants were given multiple options, and the chart visually represents the distribution of their responses.

Source: The graph was created using data from a survey conducted by the authors.

The pie chart below (Figure 5) illustrates the responses from survey participants when asked if they take too much food on their plates. 29.9% answered "Yes, often," while 35.1% responded with "Sometimes." These findings indicate that a significant number of participants acknowledge either frequently or occasionally taking more food than they can consume. This behavior contributes to food waste as uneaten portions are often discarded.

Do you usually take too much food on your plate?
77 responses

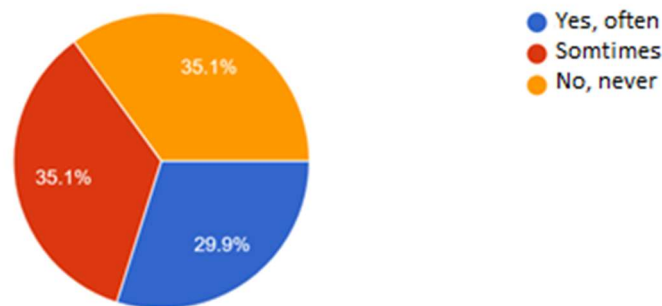


Figure 5: The pie chart illustrates the responses of the survey participants when asked about their food portion sizes.

Source: The pie chart was created using data from a survey conducted by the authors.

The pie chart below (Figure 6) illustrates the participants' responses regarding their perception of food waste in schools. The majority (74%) answered 'Yes'. This result suggests that a significant proportion of participants believe that a significant amount of food is wasted in school environments. This result underlines the need to address methods of managing food waste in schools to minimize unnecessary disposal of edible food.

Do you think there is a lot of food waste at school?

77 responses

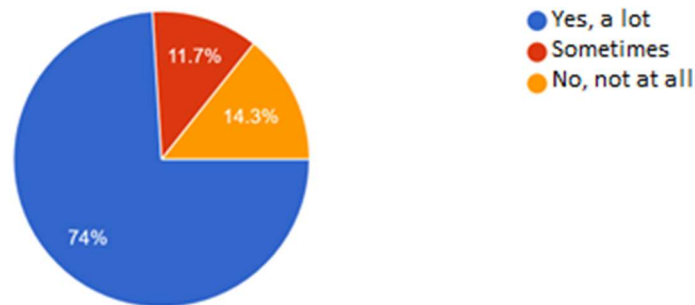


Figure 6: The pie chart displays the responses from the participants regarding their perception of food waste at school.

Source: The graph was created using data from a survey conducted by the authors.

The pie chart below (Figure 7) illustrates the responses from survey participants regarding the most commonly wasted food items in schools. They were given four categories to choose from. The majority of students (56%) indicated that the most frequently wasted food during lunchtime is vegetables and fruits. This finding highlights the importance of addressing food waste in relation to perishable items such as fruits and vegetables. It suggests the need for strategies to encourage students to consume and appreciate these food items, through educational programs and menu planning that incorporates student preferences.

Which type of food is most commonly wasted at school?

76 responses

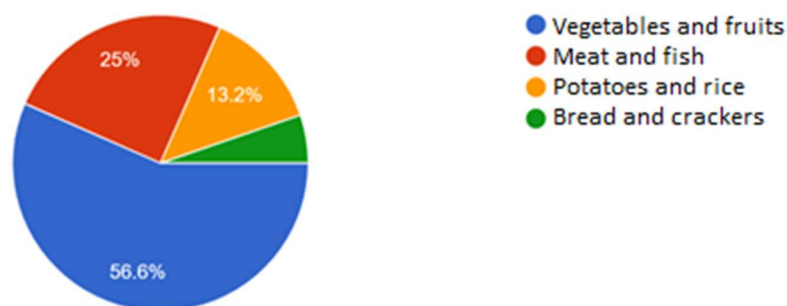


Figure 7: The pie chart showcases the responses of the survey participants regarding the most commonly wasted types of food at school.

Source: The graph was created using data from a survey conducted by the authors.

5 Discussion

The study was based on food waste in schools, which negatively affects the environment and sustainable development. The challenge for the study was to identify the underlying factors contributing to this problem and find suitable solutions. To address this challenge, various methods were used, such as interviews and surveys to collect data from students. By analyzing and interpreting this data, the study was able to draw conclusions and gain important insights into the causes of food waste.

The survey has shown that the majority of students reported that their teachers and educators do not talk about food waste in the classroom (Figure 1). This can be a significant reason why waste occurs in schools. Awareness of food waste and the importance of reducing it is crucial to living a sustainable life. When students understand how important it is not to throw away food that they cannot eat, they will change their behavior.

The students have had the opportunity to leave their own comments and suggestions in the survey. Based on the different statements from the students, we can draw the following conclusions.

The student perspective (A1) expresses that teachers should do more to inform and educate about food waste. Teaching students about food waste at a young age can be particularly important, especially since school lunch is provided for free in Sweden, which can lead to its undervaluation. It can be beneficial to help students understand what happens in other countries compared to Sweden when it comes to food waste. The reason for this is to make students aware of food problems throughout the world, make them grateful that they get free lunch at school here in Sweden, and make them care more about other people and our planet.

Additionally, the students' perspectives (A2 and A3) highlight the importance of showing students what is happening in other countries, especially in poor countries where there is famine and children barely receive one meal a day. By understanding the situation in other countries, students can gain increased awareness of the value of food and thereby reduce food waste. To achieve this, schools may consider integrating education about food waste and food appreciation into their curriculum. This may include discussions about the global food crisis, food waste statistics, and the economic and ecological consequences of food waste. By using real examples from other countries, especially those struggling with famine, students can gain insight into how their own actions can affect people around the world. Schools have a crucial role in promoting knowledge and awareness of sustainability, and this includes reducing food waste. Students need to understand that food waste is not just about throwing away food, but also about wasting the resources needed to produce it. By discussing food waste in the classroom, teachers can help students understand how they can reduce their food waste and contribute to a more sustainable future. Discussing food waste can also lead to interesting discussions about other aspects of sustainability, such as climate change and ecosystem destruction.

The student's response (A4), which describes food waste as showing ingratitude towards the staff, highlights the importance of appreciating and respecting the efforts involved in providing meals. This is a crucial aspect to consider when it comes to reducing food waste. By increasing awareness that there are people working hard to prepare and serve the food, students can gain a better understanding of the value of food and feel gratitude for the efforts made to meet their needs. By highlighting the work of the staff, a culture of respect and gratitude can be fostered. To achieve this, schools can consider organizing activities where students can interact with the staff responsible for the food, participate in cooking classes, or assist in the school kitchen. By encouraging mutual understanding and appreciation, the risk of food waste can be reduced.

Other studies have also emphasized the importance of increasing awareness through awareness campaigns. A study conducted by Pekin (2019) highlights that information campaigns play a crucial role in influencing student behavior, particularly in reducing food waste. A successful example of this can be observed in school kitchens, where food waste was reduced by more than 29% after students were exposed to information campaigns on reducing food waste (Pekin, 2019). Studies have shown that students who received such messages wasted less food compared to those who did not participate in any information campaign and how a simple awareness campaign can influence students' behavior regarding food waste (Pinto et al., 2018).

This underscores the significance of spreading knowledge and awareness about food waste among students. By informing and engaging them through such campaigns, attitudes, and behaviors related to food waste can be transformed.

According to the data collected from the survey, the main factor behind food waste in schools is that the food doesn't taste good (Figure 2). This leads to students choosing not to eat all the food or leaving leftovers on their plates if they are not satisfied with what is served.

The results of the survey show that a significant proportion of students at the school, namely 80.6%, either sometimes or never feel that the food served meets their needs and preferences, that is, the students do not like the food served (Figure 3). This may suggest challenges with the quality of the food or a need for improved planning and consideration of students' preferences in developing the school menu. Another possible reason could be that the food served lacks diversity and does not offer enough variety to appeal to students.

The survey results indicate that a diverse food experience can help reduce food waste in schools (Figure 4). This may involve serving different types of dishes instead of limiting the range of food to a specific category, such as a type of vegetable or protein source every day or week. To address this issue, schools can collaborate with professional chefs and nutritionists to create a varied menu with different types of foods that cater to students' taste preferences and are nutritious. Students can also be involved in menu planning, and their feedback and preferences can be taken into account. Additionally, by collaborating with local producers, schools can access a wider range of

local foods and ingredients, which can lead to meals that are more seasonally adapted and therefore more cost-effective. Varying the selection of dishes can increase the costs of school meals, but reducing food waste can help to lower food costs in the long run by reducing the amount of food that needs to be purchased and prepared each day.

The survey has also shown that another reason for food waste is the short lunchtime, which causes students to feel stressed about not being able to return to their classes on time (Figure 2). Even though only 13% mentioned this reason, it still appears to be significant because not all students can eat at the same speed. Some students require more time than others. One student mentioned in an interview (A7) that they sometimes eat quickly because other classes are waiting to eat. This indicates that time constraints and haste can affect students' ability to eat and consequently increase the risk of food waste.

According to Figure 4, about 14.3% of students have suggested that the lunch break should be extended, while almost 8% have suggested better time planning for lunch. This means that almost 22% of the students share the same opinion. These figures show that a significant percentage of students feel that longer lunch times and improved time management would be an effective solution to reduce stress and food waste.

These results provide further support for the need to investigate and implement measures that can give students enough time to eat during lunchtime. It would be worth investigating how to organize meals in a way that reduces stress and gives students enough time to eat at the same time as food waste is reduced. One idea is to review the schedule and see if it is possible to extend the lunchtime. Another possible solution is to examine the lunch routines and explore ways to optimize the process. For example, evaluating the queuing system and finding ways to make it more efficient, so that students do not have to stand in queues for too long. By reducing waiting time, students can have more time to eat and feel less stressed.

Another measure that the school can consider is offering a variety of eating options for students. By providing multiple locations, such as different dining halls or outdoor areas when weather permits, the school gives students the opportunity to choose an environment where they feel most relaxed and comfortable while eating. By offering different alternatives, the school can create a diverse and engaging lunchtime environment that caters to the different preferences and needs of the students.

It is important for the school to continuously evaluate and adapt its lunchtime strategies based on student feedback and needs. By creating a lunch environment that promotes student well-being and provides them with sufficient time and space to eat, the school can not only reduce food waste but also promote healthy eating habits.

According to Figure 7, a survey revealed that 56.6% of students voted for vegetables and fruits being the most wasted food in school. Interviews with students (A9 and A10) indicated that this could be due to already having access to these foods at home and finding it boring to eat the same type of food all the time. To address this issue, the

school can consider offering a more diverse menu that includes different types of fruits and vegetables that may not be as commonly available in students' home environments. For example, offering strawberries and berries instead of apples and bananas could be a refreshing change. Additionally, using bananas when making pancakes, which might be more appealing to students, can be explored. Another student mentioned liking coleslaw salad, so introducing new salad options instead of the usual ones can be beneficial. By providing new and exciting alternatives, the school can increase interest and encourage students to choose and consume these foods instead of wasting them. Therefore, the school can experiment with various cooking methods and presentations of vegetables and fruits to make them more enticing and appetizing for students. For instance, offering roasted vegetables, fruit salads, or vegetable sticks with dip can add variety to the options.

To encourage students to eat fruits and vegetables, the school can organize different activities and campaigns focusing on nutrition, healthy eating habits, and the importance of a balanced diet. By increasing awareness and knowledge among students, the school can help them recognize the value of including fruits and vegetables in their meals, even if they already have access to them at home.

Implementing portion control can also minimize excess and unnecessary waste. By serving smaller portions of vegetables and fruits, the risk of students taking more than they will actually consume is reduced. Additionally, using serving techniques that allow students to choose the number of vegetables and fruits they want can further decrease waste as they can take what they will actually eat. It is also valuable to involve students in the process by giving them the opportunity to provide feedback and suggest types of fruits and vegetables they would be interested in trying during school lunch. This way, the school can tailor its offerings to better meet students' preferences and expectations.

According to a survey, 74% of students believe that a lot of food is wasted in school (figure 6). Additionally, 30% of students state that they take too much food on their plates, while 35.1% do it occasionally (figure 5). These findings indicate challenges with overconsumption and excess food among some students. Several factors can contribute to this situation. Many students may struggle to assess appropriate portion sizes and thus take more food than they need to feel full. This could be due to a lack of knowledge about balanced eating habits and how to create a balance between calorie intake and energy expenditure.

Some students may have an instinct to take more food when it is available, especially if they perceive limited access or feel rushed to eat. This could be related to a fear of being hungry later or a belief that they won't have enough food later. Students may not be fully aware of the negative consequences of food waste, both economically and environmentally. Without a clear understanding of the importance of reducing food waste, students may be less inclined to limit their food consumption.

To address these challenges, schools can offer educational programs or workshops that focus on teaching students about appropriate portion sizes and making balanced choices during meals. By increasing students' awareness of their food needs, they can better understand how much food they require and avoid overconsumption. To further support these efforts, schools can collaborate with parents and guardians by sharing relevant information and resources about balanced diets and portion sizes. By involving the entire community, a shared understanding can be developed regarding the importance of promoting healthy eating habits among students.

To solve these challenges, the school can offer educational programs or workshops that focus on teaching students about appropriate portion sizes and making balanced choices during meals. By increasing students' awareness of their food needs, they can better understand how much food they need and avoid overconsumption. To further support these efforts, the school can also collaborate with parents and guardians by sharing relevant information and resources about balanced diets and portion sizes.

6 Conclusion

The study on food waste in schools has identified several underlying factors contributing to this problem and has proposed potential measures to reduce food waste. One of the major challenges is the lack of awareness and education about food waste among students and teachers. The survey revealed that the topic is rarely discussed in the classroom, leading to insufficient knowledge and understanding among students on how to reduce waste.

Another significant factor is dissatisfaction with the taste of the food, as reported by the majority of students. This results in either not finishing the entire meal or leaving leftovers on their plates. The study suggests that there is room for improvement in menu planning to better cater to student's needs and preferences. Offering a diverse menu and collaborating with professional chefs and nutritionists can help reduce waste and increase students' interest in the food. A short lunchtime and the stress of returning to classes on time also contribute to food waste. Some students feel rushed to eat due to the time constraint, increasing the likelihood of food being discarded instead of consumed.

To address the issue, the study proposes several measures. These include raising awareness and providing education on food waste through classroom discussions, campaigns, and curriculum integration. Schools can collaborate with chefs and nutritionists to develop a varied and nutritious menu that appeals to students. It is also crucial to involve students in menu planning and consider their feedback and preferences. Extending lunchtime or implementing more effective time management strategies can provide students with sufficient time to eat. Furthermore, emphasizing the importance of education on nutrition, healthy eating habits, and portion control is highlighted. By involving students in the process and increasing their awareness, overconsumption and unnecessary waste can be reduced.

The study highlights the need to study food waste and its causes, as well as to increase awareness of amounts and behaviors to reduce food waste. By identifying problem areas, solutions can be found and thus contribute to a more sustainable environment.

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Appendices

Appendix A: Interview questions

For pedagogues

- How many children attend the preschool?
- How does the absence reporting work, i.e. communication between educators and the kitchen?
- How does the serving work at the school? Do the children serve themselves or is the food distributed by the staff?
- Do you use colorful plates, cut fruits and vegetables into fun shapes, or offer different dipping sauces to make it more interesting for children to eat them? In other words, do you do anything special to make it more engaging for children to eat their food?
- Do educators eat with the children?
- Does the meal environment (e.g. noise level, children leaving their seats when they have finished eating resulting in more running around and chaos, number of children in the same room, too few educators eating with the children) affect the amount of waste?
- Do you report to the kitchen how much food waste is generated?
- Do you measure food waste?
- What happens to the food leftovers?
- Is there a certain type of food that is wasted more, and if so, which one?
- Do children like to eat fruits and vegetables?
- Do you feel that there is a lot of food waste at the school?
- Do children cook their own meals at school?
- What do you think affects the amount of food waste?
- Are children introduced to the problem of food waste?
- Do you have any personal reflections and ideas on how to reduce the amount of food waste?
- Any other thoughts before the interview is concluded?

For kitchen staff

- How many children attend the preschool?
- Is it a reception kitchen or a preparation kitchen?
- How does absentee reporting work, i.e. communication between educators and the kitchen?
- Is the food adapted to smaller children?
- Does the kitchen receive information about how much food waste is generated in the classrooms?
- Is there a certain type of food that is wasted more, if so, which one?
- Do you feel that there is a lot of food waste here?
- What happens to the food leftovers?
- According to you, what affects the amount of food waste?
- What are you currently doing to reduce food waste?
- Do you have any personal reflections or ideas on how to reduce the amount of food waste?

- Do you have any other questions before the interview ends?
- How is the food purchased? Do you adjust the purchases based on how much each student eats? Do you use any calculations?

For students

- Are there any dishes that you like more/less than others?
- How important is it for you that school food is varied and offers different dishes?
- Do you get enough information about what is served for lunch?
- Do you think it is important that school food is organic and sustainably produced?
- Do you get enough time to eat?
- How do you feel about the meal environment (e.g. noise level, seating at the table, etc.)?
- Is it important for you that school food is healthy?
- Are you aware of the problem of food waste?
- Do you believe that there are things that can be done to reduce the amount of food waste in schools?
- Do you have any personal reflections and ideas on how to reduce food waste in schools?
- Do you have any other questions or comments about school food and food waste?
- Do you like cooking?
- Do you prefer eating food that you have cooked yourself or that someone else has cooked for you?
- Do you like food that is presented in patterns and faces? Do you like colorful plates and cutlery?

Appendix B: Survey

What is your age? _____

What grade are you in?

- A. 7th grade
- B. 8th grade
- C. 9th grade

Do you always finish all the food served in the school cafeteria?

- A. Yes, always
- B. Sometimes
- C. No, rarely
- D. Never

If you don't finish all the food on your plate, what do you do with the leftovers?

- A. I throw it in the trash
- B. I give it to someone else

Which factors do you think contribute to food waste at school? You can choose multiple options.

- A. Oversized portions

- B. Food that doesn't taste good
- C. Too much food being served
- D. Poor selection of food items
- E. Short lunch break
- F. Hurrying to get to class after lunch
- G. Other (please specify): _____

Do you have any suggestions on how the school can reduce food waste? You can choose multiple options.

- A. Serve smaller portions
- B. Allow students to take seconds if they want more
- C. Vary the selection of food items
- D. Longer lunch break
- E. Better planning of lunchtime
- F. Other (please specify): _____

Do your teachers often talk about food waste in class?

- A. Yes, often
- B. Sometimes
- C. No, never

Do you have any other ideas or suggestions on how to reduce food waste at school?

Yes / No

How often do you eat food served at school?

- a. Every day
- b. A few times a week
- c. Rarely or never

Do you think the food served at school fits your needs?

- a. Yes, always
- b. Sometimes
- c. No, never

Do you tend to take too much food on your plate?

- a. Yes, usually
- b. Sometimes
- c. No, never

Do you think a lot of food is wasted at school?

- a. Yes, a lot
- b. Sometimes
- c. No, not at all

Which type of food is often wasted at school?

- a. Vegetables and fruit
- b. Meat and fish
- c. Potatoes and rice
- d. Bread and crackers

Do you know what food waste is?

- a. Yes, very well
- b. Somewhat
- c. No, not at all

Have you ever learned about how to reduce food waste?

- a. Yes, several times
- b. Sometimes
- c. No, never

Do you have any personal ideas or suggestions on how to reduce food waste at school?
(a free text response)

Thank you for your participation!