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LUNCHBOX LEFTOVERS

Piloting an innovative project to reduce
food waste in schools

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Executive Summary

With funding support from EPA NSW; the MidWaste Regional Waste Forum and BehaviourWorks Australia have collaborated in the delivery of *Lunchbox Leftovers*, a small-scale pilot project that trials three food waste reduction interventions within schools:

1. A new school policy that requires students to take any leftover food home.
2. A school-based program that promotes greater student involvement in making food for school.
3. A school-based timetabling switch that has students play before eating at lunchtime

Working with nine schools in the NSW Mid-coast region, Lunchbox Leftovers aimed to test the implementation of these interventions over Term 3 in 2020 and to measure different behavioural and waste reduction outcomes. Changes in behaviours to do with students eating more food at school, taking leftover food home and becoming more involved in making food for school were hypothesised, as was an overall reduction in food waste in schools.

Two schools participated in the first intervention, five in the second intervention, and two in the third intervention. Only primary-aged students took part and some schools elected to only have grades 3-6 participate. A comprehensive mix of pre-and post-intervention surveys, parental and teacher interviews, and food waste photo-audits was utilised to capture the different outcomes of the interventions.

The outcomes from this pilot project were very positive and showed a reduction in school food waste, as well as changes in a number of target behaviours, and hinted at changes in food provisioning practices and food waste reduction in student homes. This report describes detailed outcomes for schools participating in each intervention, but in summary:

Behavioural outcomes

- **Students involved in choosing and making food for school:** Two interventions, Leftovers go home and Promoting student involvement in making food for school, substantially increased the uptake of this behaviour by students. Student surveys revealed a statistically significant effect on this behaviour by these interventions, an outcome that was also evident in teacher and parent interviews.
- **Amounts of food eaten by students at school:** Students involved in the Play before eating intervention reported eating more food by the end of the term, and this was supported by interviews with teachers and parents from participating schools.
- **Students taking leftover food home:** It was difficult to draw strong conclusions about this behaviour as only percentages outcomes could be generated and statistical significance could not be tested.
- **Other behaviours:** There was a noticeable reduction in food packaging waste in a number of participating schools and an increase in students bringing healthier food options to school. Teachers from three of the nine participating schools also noticed improvements in student classroom behaviours during the interventions.

Food waste outcomes

- **In schools:** Food waste reductions were noticeable through photo audits and teacher interviews in six of the nine participating schools, indicating a positive association with the interventions being trialled by the Lunchbox Leftovers program. Schools that participated in each of the interventions demonstrated a reduction in food waste, with the schools participating in the Promoting student involvement in making food for school intervention showing the most consistent trend.

- **In homes:** Parental interviews from each intervention also hinted at changes in food provisioning practices in student homes, mainly to do with greater involvement of children in making food for school and parents providing children with more appropriate amounts of food. Both of these practices are reported to lead to food waste reduction by both research literature and on the ground practice.

The outcomes from this pilot present an exciting opportunity to change behaviours and increase food waste reduction in NSW schools and homes. We recommend a much-expanded trial in NSW schools of a new and improved Lunchbox Leftovers program that:

- *Combines* the Promote students making food for school and School policy that food goes home interventions into one more comprehensive initiative.
- Offers Play before eating as an *optional extra* for schools willing to take it up.
- *Maintain the existing communication and engagement materials* for schools to use, while *building the educational resources* for teachers to use in class-rooms with students.
- *Explores possible partnerships* with other programs in NSW that promote food waste reduction and healthy eating to school students and families.
- *Maintains a strong focus on monitoring and evaluation* adapted from this pilot program, to both track outcomes and keep schools engaged.

1. Introduction

MidWaste is a voluntary regional waste group representing six Mid North Coast councils in NSW that work together to improve regional resource recovery and waste management. MidWaste is currently delivering an EPA NSW funded Love Food Communities (LFC) program provided under the NSW Government's Waste Less Recycle More initiative. The LFC project is an important part of the NSW Government's commitment to halve food waste by 2030.

BehaviourWorks Australia (BWA) is a behaviour change research enterprise within the Monash Sustainable Development Institute (MSDI) at Monash University. Established in 2011 as a consortium partnership, BWA is now the largest applied behaviour change research unit in Australia.

Based on a previous project with the Western Australian Waste Wise Schools project¹, BWA developed three schools-based food reduction interventions at prototype stage (see next section). With funding support from EPA NSW, MidWaste and BWA collaborated in the delivery of *Lunchbox Leftovers*, a small-scale pilot project to trial these interventions with schools in the Mid North Coast region and to measure behaviour change and food waste reduction outcomes.

The following sections of this report:

1. Describe the three interventions and their anticipated outcomes
2. Present the Lunchbox Leftovers approach and methods, including information about the participating schools, the implementation of the interventions, and the outcome measurement and analysis approaches.
3. Describe and summarise the different outcomes measured for each of the interventions
4. Consider the key success factors and challenges of each intervention
5. Propose how the interventions might be modified, and expanded, based on the learnings from this pilot

¹ For more information:

- Project [report](#) on Waste Wise Schools website
- Boulet et al (2019) "Return to sender: a behavioural approach to reducing food waste in schools" *Australasian Journal of Environmental Management*. 26(4): 328-346.

2. Food Waste Interventions

The original Waste Wise Schools study focused on two key behaviours that were hypothesised (through literature review and practitioner consultation) to reduce the amount of food waste in schools:

- students take any leftover food home after a day at school
- parents involve children in choosing and making food for school.

Based on insights gathered from surveys of parents and students, three school-based interventions were proposed to encourage these behaviours and to reduce food waste:

1. *A new school policy that requires students to take any leftover food home.* This policy would encourage the first target behaviour and reduce on-campus food waste by ensuring that leftovers are taken home rather than being disposed of at school. By having students take leftovers home, this intervention also aims to increase parental awareness of what their children were eating (and not eating) at school, and in turn modify how much, and what type, of food their children take to school. It was also hypothesized that this intervention might encourage the second target behaviour, as parents ask for greater input and involvement from their children in making food for school.
2. *A school-based program that promotes greater student involvement in making food for school.* Research and practitioner evidence suggest that students would eat more food at school, and reduce food waste, if they have greater involvement in choosing or making food at home for school. This intervention encourages the second target behaviour through regular weekly engagement and communication with students and their parents.
3. *A school-based timetabling switch that has students play before eating at lunchtime.* Previous research has found that students ate more food at school if they were allowed to play first and then eat. This intervention does not aim to encourage either of the two target behaviours, it is focused only on reducing food waste at school by increasing student consumption of food that they have brought from home.

The Lunchbox Leftovers pilot project aims to test the implementation of these interventions within schools, to measure whether their anticipated behavioural and waste reduction outcomes occurred, and to compare how these outcomes differed between interventions. The next section provides an overview of participating schools, describes the implementation of the interventions, and how outcomes were measured and analysed.

3. Methods

3.1. Participating schools

A total of nine schools from the NSW Mid North Coast region were recruited by MidWaste via an expression of interest process. Promoted under the banner of Lunchbox Leftovers, each school was asked to select one of the interventions based on their perceived interest and capacity. Table 1 summarises the participating schools and their chosen intervention, and indicates the approximate numbers of students that took part in each school.

Table 1: participating schools, the interventions they are trialling and the number of students involved

School	Intervention	# students involved
Crossmaglen School	Play before eating at lunch time	Whole school (approx. 35 students)
Smithtown Public School	Play before eating at lunch time	Whole school (approx. 70 students)
Kinchela Public School	School policy that leftover food goes home	Whole school (approx. 20 students)
St Mary's Primary Bellingen	School policy that leftover food goes home	Whole school (approx. 120 students)
Kempsey Adventist School	Promote student involvement in making food for school	Whole of primary school (approx. 300 students)
Lansdowne Public School	Promote student involvement in making food for school	Whole school (approx. 30 students)
St Columba Anglican School	Promote student involvement in making food for school	Years 3 – 6 (approx. 330 students)
Bungwahl Public School	Promote student involvement in making food for school	Whole School (approx. 40 students)
Aldavilla Primary School	Promote student involvement in making food for school	Whole school (approx. 300 students)

Two schools participated in the first intervention (*school policy that leftover food goes home*), five in the second intervention (*promoting greater student involvement in making food for school*), and two in the third intervention (*play before eating at lunch time*). There was considerable variation in school sizes (from small rural to large urban based) and the number of students participating in each intervention. Only primary-aged students took part and some schools elected to only have grades 3-6 participate.

3.2. Intervention implementation

All schools participated in the photo audit within the first two weeks of Term 3 (see below) and then implemented their chosen initiative from the fourth week of the third term of 2020. Interventions were completed by the tenth week of the term (ensuring that post-intervention measurements could still be completed in the final two weeks).

MidWaste supported all schools with a suggested implementation schedule, a variety of administration, communication and educational materials, and a hands-on educational workshop for students during the term that focused either on making bees-wax wrappers or composting. MidWaste also developed 'Make

your own lunch’ workshop content and resources but due to Covid this was provided to schools to deliver themselves (see Appendix A for MidWaste’s communication and education collateral).

Each school had a teacher, or the principal, who was responsible for the initiative and was the main point of contact. MidWaste also supported schools in the various outcome evaluation activities outlined below, providing them with the different resources required to collect data from students and parents, and prompting them to meet necessary deadlines. MidWaste also provided extensive media support for participating schools (see Appendix I).

3.3. Outcome evaluation

The behavioural and food waste outcomes from the three interventions were captured with a mix of outcome evaluation methods. These are summarised in Table 2 and each method is described in further detail below.

Table 2: Evaluation methods used to measure project outcomes

Outcome	Methods
School food waste	<ul style="list-style-type: none"> Pre- and post-intervention photo audits of selected school bins Post-intervention interviews with lead teacher in school
Target behaviours	<ul style="list-style-type: none"> Pre- and post-intervention surveys of students and parents. Post-intervention interviews with parents Post-intervention interviews with lead teacher in school
Other impacts and general feedback	<ul style="list-style-type: none"> Post-intervention interviews with parents Post-intervention interviews with lead teacher in school

Photo-audits of school bins: MidWaste educators visited each school at the beginning of Term 3 to identify (with the lead teacher) relevant class-room and school-yard bins that collected food waste. These were marked and educators emptied each bin onto a tarpaulin and took a single photo of its contents. A ruler was placed next to each pile of waste to provide a point of reference and standardization in the photo, as well as a tag with the number of each bin. The educators returned to each school at the end of Term 3 and repeated the same process with each marked bin (see Appendix B for the process that MW educators followed at each school).

An informal visual analysis was conducted of pre- and post-intervention photos, comparing overall food waste amounts (of food scraps and of uneaten food items) and then comparing rough numbers of uneaten food items between photographs (see Appendix G for examples of pre- and post-intervention photos and their comparisons).

Student and parent surveys: Online surveys were completed by students and parents at each school at the start and end of the interventions in Term 3. Pre- and post- intervention surveys were nearly identical in their format and questions. Students completed their surveys in class at school, while parents were sent links by the schools and asked to complete the surveys in their own time. One school sent the pre-intervention surveys to parents as hard-copies as there was concern that they might struggle with the online versions. This school reverted to the online surveys for the post intervention phase.

Student surveys measured the self-reported participation of students in the targeted food waste behaviours, and their reports on how much food they usually eat at school (see Appendix C for the

student pre-survey). The target behaviour *parents involve children in choosing and making food for school* was separated into two questions; one that asked students to self-report their involvement in choosing food for school and the other about their involvement in making food for school. While there was overlap in these questions, they were separated to make it easier for the students to respond to, as well as to pick up any differences for students between simply choosing food for school and actively making it.

Parent surveys measured their perceptions of their children's participation in the targeted food waste behaviours, and their estimates of how much food their children usually eat at school (see Appendix D for the parent pre-survey). The target behaviour *parents involve children in choosing and making food for school* was also separated into two questions to align with the format in the student survey.

The use of both student and parental surveys was given approval by the Monash University ethics committee (I.D. 24435) and the NSW Department of Education and Training's Research Office (Serap ID: 2020182).

To test for statistically significant effects from the interventions on the target behaviours, a linear mixed model analysis was conducted on data collected from parent and student surveys. More standard approaches, such as a t-test or chi-square tests, are inappropriate to analyse the outcomes from interventions because they assume that each individual is independent. In this study however students (and parents) are nested within classes, and classes are nested within schools, so individuals are not truly independent. Mixed models analysis accounts for this 'nesting' and leads to more accurate conclusions about the actual impact of the interventions within schools.

Lead-teacher interviews: Fifteen-minute post-intervention phone interviews were conducted with lead teachers (or principal) from each school by the MidWaste project manager. These captured teacher observations of food waste outcomes, as well as student and parent behavioural outcomes from the interventions. Lead teacher insights into the success factors, and challenges, of each intervention were also sought (see Appendix E for the interview schedule)

Parent interviews: The parental post-intervention surveys gave parents the option to nominate to be contacted for an additional fifteen-minute interview. These captured further detail from parents about any changes in behaviours, or other outcomes, they noticed in their children or themselves as a result of the interventions. The interviews were also used to gather more general feedback from the parents about the interventions (see Appendix F for the interview schedule).

Parental interviews were approved by the Monash University ethics committee (I.D. 24435) and the NSW Department of Education and Training's Research Office (Serap ID: 2020182).

4. Results

This section presents the food waste and behavioural outcomes identified for each intervention through the different data collection processes. Appendix H presents the data collection totals (i.e. how many surveys and interviews were completed) for all interventions. While a decent sample of parent surveys were collected at the pre-intervention stage, this was substantially reduced at post-intervention. For some schools, no parents completed the post-intervention survey. This created a number of problems when analysing the results from this data stream and we did not have confidence in the robustness of the outcomes. It was therefore decided not to include the results from the parent interviews in this study.

Each school had some variation in their implementation of the different interventions, and a number ran complementary programs at the same time as the intervention from LunchBox Leftovers. These delivery variations for each school are also described below.

Please note, these results do not include the extensive local media coverage that was generated by this project. See Appendix I for examples or contact MidWaste for further information.

4.1. Intervention 1: School policy that leftover food goes home

Two schools participated in this intervention:

- *St Mary's Primary Bellingen*: followed the intervention as guided by MidWaste materials and did not use any educational materials with students in class.
- *Kinchela Public School*: made a number of changes on campus while running this intervention, including new signage on bins, focused on lunchboxes in cooking classes each week as a component of the [OzHarvest FEAST](#) program, taught about food waste, health and packaging issues in class, and did a student lunchbox audit.

Behavioural outcomes

Table 3 shows the effect of this intervention on the target behaviours based on student surveys. To ensure a robust sample size, these outcomes are presented at the intervention level, rather than for each school. To summarise:

- *Students involved in choosing food for school*: No statistically significant effect of this intervention on students bringing leftovers home was detected.
- *Students involved in making food for school*: A statistically significant effect of this intervention was detected on students' involvement in making food for school. Namely, students reported being more involved in making food for school after the intervention than before.
- *How much food students eat at school*: No statistically significant effect of this intervention on students bringing leftovers home was detected.
- *Students bring leftovers home*: It was not possible to include this behaviour in the statistical model due to the different structure of the relevant survey questions. Descriptive analysis of the results of this question showed that 68% (53/78) student respondents across both schools reported taking leftovers home before the intervention, compared to 53% (39/73) of student respondents after the intervention.

Table 3: Estimates of effects, statistical significance and margins of error of the Taking leftovers home intervention on target behaviours from student surveys

Behaviour	Effect estimate	Significance	Margin of error (95% confidence interval)	
			Lower bound	Upper bound
Choosing food	0.138973	0.344	-0.15224	0.430186
Making food	0.297932	0.042	0.011359	0.584504
How much food is eaten	0.033452	0.844	-0.302495	0.369399

It should be noted that there are relatively large margins of error associated with each effect in Table 3. This stems from a relatively small sample size of student respondents in both schools (see Appendix H) and means we need to be cautious of how representative the effects, and their statistical significance, would be of the broader NSW school population.

The teacher interviewed at Kinchela reported an increase in healthy foods brought to school, a reduction in plastic packaging in lunchboxes, and more appropriate use of waste bins by students (i.e. they put waste in the right bins). Students started bringing fruit and sandwiches rather than packaged, highly processed food and eating more of their food. She also commented that students seemed to be significantly more able to concentrate and sit still in class.

The St Mary’s teacher interviewed had less to say about behavioural outcomes. She did notice that at daily fruit time the students were more conscious of not throwing out whole pieces of fruit with only two bites. Only one St Mary’s parent was interviewed from these two schools.

“[The intervention is a] Great idea, rather than kids throwing anything leftover into bins at school to bring to back home again so that the parents can see what is not working.”

The amount of waste her children were bringing back made her realise that her children should be involved making decisions about the food they take to school, as well as involved in actually making their food. This aligns with the effect on students making food as detected in the student surveys.

“I reckon if the kid is in the kitchen, actually standing at the bench and actually making their own lunch ... you are so much more likely to see that child eat, as they have been part of that process ... I’m really happy because we have heaps less waste.”

Food waste outcomes

See Appendix G for the collated pre and post-intervention photo audits of Kinchela and St Marys. Due to changes in waste bins at Kinchela, it was difficult to compare between pre and post audits, as there were different numbers of bin and not the same number of photos taken. Food waste was only evident in one bin in the post-intervention photos.

The Kinchela teacher interviewed reported that the amount of waste in school bins had reduced from two overflowing bins to one full bin over the term (more than 50% reduction).

There was a very noticeable reduction in food waste in post-intervention photos at St Mary’s compared to pre-intervention ones. No uneaten food was evident in post-photos. The teacher at St Mary’s reported that she noticed less whole fruit was going into bins.

Intervention outcome summary

- Based on student surveys, the Leftovers go home intervention showed a statistically significant effect on increasing the involvement of students making food for school. No other significant effects were detected for the other target behaviours.
- While the statistical significance of the difference could not be calculated, a smaller percentage of students reported taking leftovers home from school after the intervention than before. This is counter to the aims of this intervention and might come from student's difficulty in answering the relevant question about this behaviour in the survey. Comments in the open text section of this question showed that many either did not understand the question and a number mentioned variation in what they did depending on the day and the food item.
- An interview with a parent from St Mary's showed how this intervention may also have had an impact on food provisioning practices in the homes of students, one which can reduce food waste in that context. This is supported by student survey showing that more were involved in making food for school at home after the intervention.
- Based on the photo audits and teacher interviews, there was a noticeable reduction in food waste at both schools over the course of the term.
- While this intervention showed some very positive trends in behavioural and food waste outcomes (except for the target behaviour of taking leftovers home) caution is warranted due to the small sample size of student surveys and to the possible confounding impacts from the other changes made at Kinchela over the term.

4.2. Intervention 2: Promote greater student involvement in making food for school

Five schools participated in this intervention:

- *Lansdowne Public School:* participated in the OzHarvest FEAST food waste program at the same time
- *St Columba Anglican School:* had removed all school-yard bins earlier in the year, used MidWaste education content in weekly classes, had a merit system and acknowledged students in assemblies for reducing food and packaging waste, as well as healthy eating.
- *Kempsey Adventist School:* put all MidWaste content into video assemblies for students each week plus held make your lunch sessions using MidWaste resources
- *Aldavilla Public School:* has an active environmental sustainability program across the school and a student enviro team that conducts waste audits. They included healthy eating lessons throughout the term.
- *Bungwahl Public School:* included MidWaste education content in weekly classes and in whole of school presentations

Behavioural outcomes

Table 4 shows the effect of this intervention on the target behaviours based on student surveys. To ensure a robust sample size, these outcomes are presented at the intervention level, rather than for each school. To summarise:

- *Students involved in choosing food for school:* A statistically significant effect of this intervention was detected on student's involvement in choosing food for school. Namely, students reported being more involved in choosing food for school after the intervention than before.

- *Students involved in making food for school:* A statistically significant effect of this intervention was detected on student’s involvement in making food for school. Namely, students reported being more involved in making food for school after the intervention than before.
- *How much food students eat at school:* No statistically significant effect of this intervention on students bringing leftovers home was detected.
- *Students bring leftovers home:* It was not possible to include this behaviour in the statistical model due to the different structure of the relevant survey questions. Descriptive analysis of the results of this question showed that 60% (350/582) student respondents across both schools reported taking any leftovers home before the intervention, compared to 58% (284/487) of student respondents after the intervention.

Table 4: Estimates of effects, statistical significance and margin of error of the Taking leftovers home intervention on target behaviours from student surveys

Behaviour	Effect estimate	Significance	Margin of error (95% confidence interval)	
			Lower bound	Upper bound
Choosing food	0.336729	0.000	0.207241	0.466217
Making food	0.260717	0.000	0.123126	0.398309
How much food is eaten	0.006394	0.910	-0.105176	0.117964

It should be noted that there are relatively smaller margins of error associated for the effects in Table 4. This stems from a larger sample of student respondents in the survey and creates greater certainty as to how representative the effects, and their statistical significance, would be of the broader NSW school population.

Teachers interviewed from St Columba, Bungwahl and Aldavilla all identified substantial increases in the number of students bringing food to school they made themselves. Teachers from St Columba and Bungwahl also mentioned a reduction in plastic packaging evident in student lunchboxes. While not associating this change with the intervention, the teacher from St Columba commented that student behaviour has been unusually good over the term.

The teacher at Lansdowne noticed an increase in healthy lunches and more students eating their lunch when the school held a Make Your Own lunch day. This was not noticeable during other days of the term, although students seemed more aware of not throwing food waste in the bin. The teacher interviewed at Kempsey did not mention any specific changes in student behaviour that she noticed over the term.

Only parents from St Columba and Aldavilla were available to be interviewed. All three parents interviewed from St Columba noticed an increased involvement from their children in making food for school.

“I always make my kids lunches and they have never offered to make them [until now].”

Parents commented that their children were interested in trying a greater range of foods and also making sure there were more healthy options put in lunchboxes, and reducing plastic waste. Due to the bins being removed at St Columba, students were now bringing more of their uneaten food home and one parent mentioned that it allowed the family to discuss why things were not eaten and to make some changes.

Another St Columba parent commented that:

“[This program] has been a long time coming. I have noticed the impacts of the packaging food and the waste that goes on for a long amount of time... I think that it was the perfect thing for our kids to be involved in and I think it will impact in how we continue to prepare food and what we eat. Hope it continues and that other schools take it up.”

The parent interviewed from Aldavilla reported that her children had stopped taking sandwiches and yoghurts to school because they get too warm/soggy to eat and they felt like it was just a waste.

Food waste outcomes

See Appendix G for the collated pre and post-intervention photo audits of the five schools involved in this intervention.

- *Kempsey:* Less food waste overall, but not a strong noticeable trend with regards to uneaten items. There was a mix of scraps and uneaten food visible in pre and post-intervention photos. Two bins showed less food waste overall in the post-intervention photos, while one showed more, and one about the same as the pre-intervention photo. The Kempsey teacher interviewed did not mention any reduction in food waste at school.
- *Aldavilla:* Three bins showed an overall reduction in waste amounts between pre and post-intervention photos, with less uneaten items noticeable in post-photos. Two bins show roughly similar amounts with more uneaten items in post-photos. The Aldavilla teacher interviewed noticed a slow but steady reduction in food waste over the term. It was higher than usual (approximately two bins worth) when students returned to campus from Covid-19 remote-schooling and went to about half that amount by the end of the term.
- *Lansdowne:* More food waste overall, and uneaten food items, was visible in post-intervention photos than in pre-intervention photos. The Lansdowne teacher interviewed did not mention noticing any reduction in food waste at the school over the term.
- *St Columba:* There was a very clear trend in reduction of food waste between pre and post-intervention photos. The St Columba teacher interviewed mentioned that the school had cut back to one bin for food waste (they used to have one for every class). She also noticed a reduction in number of whole sandwiches and other uneaten food items in bins.
- *Bungwahl:* Overall volume of food waste was less in post-intervention photos compared to pre-photos. There was very little uneaten food visible in any of the post-photos. The Bungwahl teacher interviewed noted that there seemed to be less food waste than usual throughout the term but did not provide any quantitative estimates of the scale of this reduction.

Intervention outcome summary

- Based on student surveys, this intervention showed a statistically significant effect on increasing the involvement of students choosing and making food for school.
- The outcomes of teacher and parent interviews aligned with findings from the student surveys and reported greater student involvement in making lunches, with a greater focus on healthy eating and reducing packaging waste.
- Parental interviews also hinted at changes in food provisioning practices in student homes, ones which can reduce food waste in that context.
- Based on the photo audits and teacher interviews, three of the five schools participating in this intervention showed significant food waste reductions.

- There was not a significant effect from the interventions on students eating more, which suggests other causal mechanisms at play in schools that reduced food waste. This may have come from bin removal (at St Columba) encouraging more food waste to go back home or from parents making changes at home to reduce the amount of food wasted as a result of their engagement from the school.

4.3. Intervention 3: Play before eating

Two schools participated in this intervention:

- *Crossmaglen Public School:* Due to feedback from teachers and students, the school made early changes to the intervention and implemented a ‘eat, play, graze, play’ approach to lunchtime. The school also participated in the FEAST program throughout the term. This involved the delivery of food waste avoidance content in class each week, but did not include the program’s cooking component due to Covid-19 restrictions.
- *Smithtown Public School:* also ran this intervention at the same time as the FEAST program, which included cooking and discussing food waste each week in class.

Behavioural outcomes

Table 5 shows the effect of this intervention on the target behaviours based on student surveys. To ensure a robust sample size, these outcomes are presented at the intervention level, rather than for each school. To summarise:

- *Students involved in choosing food for school:* No statistically significant effect of this intervention on students bringing leftovers home was detected.
- *Students involved in making food for school:* No statistically significant effect of this intervention on students bringing leftovers home was detected.
- *How much food students eat at school:* A statistically significant effect of this intervention was detected on how much food students eat at school. Namely, students reported eating more at school after the intervention than before.
- *Students bring leftovers home:* It was not possible to include this behaviour in the statistical model due to the different structure of the relevant survey questions. Descriptive analysis of the results of this question showed that 63% (31/49) student respondents across both schools reported taking leftovers home before the intervention, compared to 67% (33/49) of student respondents after the interventions.

Table 5: Estimates of effects, statistical significance and margin of error of intervention on target behaviours from student surveys

Behaviour	Effect estimate	Significance	Margin of error (95% confidence interval)	
			Lower bound	Upper bound
Choosing food	0.330871	0.225	-0.208317	0.870059
Making food	0.071727	0.749	-0.378358	0.521813

How much food is eaten	0.420194	0.048	0.003243	0.837145
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It should be noted that there are relatively large margins of error associated with each effect in Table 5. This stems from a small sample size of student respondents in both schools and does create some uncertainty as to how representative the effects, and their statistical significance, would be of the broader NSW school population.

The teachers interviewed from both schools reported changes in student behaviours over the term. At Crossmaglen, the teacher observed that the students were much more mindful about what they didn't eat during a typical school day and had started packing what they thought they could eat at school. The Smithtown teacher reported that students ate more food and noticed that they had more healthy food in their lunchboxes. While these results are complementary to the intentions of the Play before eating intervention, they may also stem from both schools' participation in the FEAST program.

At Smithtown, the teacher interviewed also noted that students seemed more settled in class after the lunchbreak. This may have been due to more food being eaten at lunchtime and students being given a chance to settle down after playing. A similar outcome has been reported in other studies testing this intervention². However, there was uncertainty at Smithtown as to whether this change occurred due to the intervention or to other teaching changes that had been introduced during the term. One of the Smithtown parents interviewed was also a teacher at the school and she noted how eating after play-time gave the students a chance to resolve 'playtime politics' and refocus before the next lesson. Her class felt a bit more settled as a result, but she wondered if this was from students having a chance to pause before class rather than from eating food after play.

Aligning with student survey outcomes, two Smithtown parents interviewed mentioned an increase in the amount of food eaten by their children during the term. One felt that while there was more eaten at the start of the term, her child seemed to revert back to 'normal' towards the end. She did notice that the 'major part' of the lunch (the main sandwich etc.) was always eaten throughout the term, which had not been the case before.

One of the Smithtown parents has started giving less food to her child to take to school, as she noticed how much was not being eaten, and realised that her child did not need as much food as thought.

Food waste outcomes

See Appendix G for the collated pre and post-intervention photo audits of Smithtown and Crossmaglen. There was a noticeable reduction in the overall volume of food waste (scraps and uneaten items) for Crossmaglen, with much less uneaten food items evident in the post-intervention photo. For Smithtown, a difference in food waste amounts could not be visually detected between the pre and post-intervention photos. If anything, there seemed to be slightly more food in two of bins in the post-audit photos.

The teachers interviewed from both schools noted that there seemed to be less food waste than usual throughout the term. Both were not able to provide any quantitative estimates of the scale of this reduction.

Intervention outcome summary

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- Bark et al. (2010) "Scheduling recess before lunch: exploring the benefits and challenges in Montana Schools." *Journal of Child Nutrition & Management*; 34(2): 8.
- Rainville et al. (2009) "Recess before lunch in elementary schools: development of a best practice checklist." *Journal of Child Nutrition and Management*. 33(2).

- Based on student surveys, the Play before eating intervention showed a statistically significant effect on increasing the amount of food that students reported eating at school. This supports one of the main hypotheses of this intervention, that students would eat more because they were hungrier due to playing before eating.
- No other significant effects were detected for the other target behaviours.
- An increase in food eaten was also identified in parent interviews and one teacher interview. Parental interviews also hinted at changes in food provisioning practices in student homes, ones which can reduce food waste in that context.
- Based on the photo audits of school waste bins, there was noticeable reduction in the food waste amounts for Crossmaglen in post-intervention photos.
- While this intervention showed positive trends in expected behavioural and food waste outcomes, caution is warranted due to the small sample size of student surveys and to the possible confounding impacts from the FEAST program.

4.4. Outcome summary and reflection across all interventions

Behavioural outcomes

- **Students involved in choosing and making food:** There was a very strong positive trend identified in this behaviour across two interventions, Leftovers go home and Promoting student involvement in making food for school. Student surveys, and teacher and parent interviews all highlighted this effect, especially for the second intervention.
- **Amounts of food eaten by students at school:** Students involved in the Play before eating intervention reported eating more food by the end of the term, and this was supported by interviews with teachers and parents from participating schools.

The other two interventions did not seem to have an effect on how much food students ate, which was surprising as both had a positive effect on students' involvement in making food. This result runs counter to existing research and practice experience and might be the outcome of student inaccuracy in reporting how much they typically eat for school. It was also noticeable that pre-intervention estimates by students of how much they eat at school were already quite high. Any positive effect of these interventions on this outcome might therefore be very small and need a much larger student sample to reveal.

- **Students taking leftover food home:** It was difficult to draw strong conclusions about this behaviour as only percentages outcomes could be generated and statistical significance could not be tested. The Take leftovers home intervention specifically targeted this behaviour, yet it was noticeable that less students reported taking leftovers home at the end of the term than before. We are not able to explain this trend, other than to suggest that short-comings in the survey questions relevant to this behaviour may have confused students or have been too limited to capture what actually happens. An interview with a parent in a participating school did indicate that some students were now bringing leftovers home.
- **Other behaviours:** There was a noticeable reduction in food packaging waste in a number of participating schools and an increase in students bringing healthier food options to school.

Teachers from three of the nine participating schools also noticed improvements in student classroom behaviours during the interventions. These comments came unprompted and this outcome was not deliberately tracked by this pilot, however it is worth highlighting this possible association with

eating more food, and healthier food, at school and more settled students in class, as it aligns with other research.

Food waste outcomes

- **In schools:** Food waste reductions were noticeable through photo audits and teacher interviews in six of the nine participating schools, indicating a positive association with the interventions being trialled by the Lunchbox Leftovers program. Schools that participated in each of the interventions demonstrated a reduction in food waste, with the schools in the Promoting student involvement in making food for school showing the most consistent trend.
- **In homes:** Parental interviews, and student surveys, also hinted at changes in food provisioning practices in student homes, mainly to do with greater involvement of children in making food for school and parents providing children with more appropriate amounts of food. Both of these practices at home are reported to lead to food waste reduction by both research literature and on the ground practice.

5. Success factors and challenges

This section summarises both teacher and parent feedback about some of the key success factors, and challenges, across all three interventions.

Success factors

- The on-going support from MidWaste over the term was critical for many schools, and having an educator come to do the audits was very valuable to get schools started on the right track.
- The MidWaste communications guide, educational and workshop content was seen to be very useful and easy to use. Schools used it to promote to their communities through Facebook pages, websites, apps and newsletters. The media releases also helped a number of schools showcase what they were doing and generated great local media interest.
- Active student buy-in to implement this intervention was very important, as was communication with parents. The teacher from Kinchela commented that they had tried to tackle lunchbox waste and healthy eating previously but that it didn't work. The Lunchbox Leftovers intervention framed it differently by targeting the students and (together with FEAST) fostered healthy eating and less waste.
- Educational materials for teachers to use weekly in class or during assemblies were seen as very important and requested by almost all schools.
- Continual recognition by teachers, and the school, of the efforts that students were taking to make food and reduce waste – through merit points, recognition in assemblies etc – was also considered to be a success factor.
- A number of teachers commented that the student and parent surveys, photo audits, and teacher interviews provided good accountability and measurability for schools.
- Schools that ran the Ozharvest FEAST at the same time commented on the great synergy between the two initiatives.
- A Smithtown parent and teacher interviewed comment that the Play before eating intervention seemed to work well for those students who are were really active and just wanted to rush out into the playground. Whereas less active kids complained they were hungry and wanted to eat before playing.

What was challenging and needed to change?

- Schools generally found it difficult to get parents to complete the surveys. It was even harder with Covid restrictions because there is less than usual face-to-face communication with parents.
- Schools that participated in Leftovers go home intervention commented on initial backlash from parents unhappy with waste being brought home and who felt judged on the food they were providing their children for school.
- Parents from schools that participated in Promote greater involvement of students in making food also felt some pressure to help their children at home. It was seen by some as yet another thing to organise for and clean-up, and hard to do when tired or busy. Others reported feeling shame for their children that their lunchboxes were being opened and felt judged.
- Covid-related hygiene requirements were much higher than normal and this made implementing play before eating a bit more difficult.
- For smaller schools the various communication and other requirements from the intervention created a challenging administrative burden for small office teams.

6. Recommendations and next steps

The very positive behavioural and food waste outcomes from this pilot program, as well as the learnings from the implementation of the different interventions, point the way to a new and refined Lunchbox Leftovers program. This presents an exciting opportunity to consolidate the outcomes from this pilot while expanding food waste reduction in NSW schools and homes. We recommend a much-expanded trial in NSW schools of a new Lunchbox Leftovers program that:

- *Combines* the Promote students making food for school and School policy that food goes home into one more comprehensive intervention. The first had the most robust and extensive behavioural and food waste outcomes while the second ‘closes the loop’ on the movement of food from the home to school and back. One of the ‘standout’ schools – St Columba – already had *removed bins from class-rooms* and required students to take leftovers home before participating in the Promote students making food for school intervention. It showed substantial food waste reductions based both on teacher reports and the photo audits.
- Offers Play before eating as an *optional extra* for schools willing to take it up. While there were positive outcomes associated with this intervention, both participating schools struggled with its implementation and had to manage complaints from both students and parents.
- *Maintain the existing communication and engagement materials* for schools to use, while *building the educational resources* for teachers to use in class-rooms with students. Food waste education was not an initial focus of any of the interventions, yet resources were developed during the term at the request of teachers. They felt that teaching the students about food waste aligned better with the interventions, even if it was not necessarily required to encourage the target behaviours.
- *Communication with parents is modified and enhanced* to avoid being seen to be judgemental and shaming parents. Additional how-to-guides, such as easy recipes to follow and tips to make involving children easy, could be provided to provide further support at home.
- *Explores possible partnerships* with other programs in NSW that promote food waste reduction and healthy eating to school students and families. The strong synergy, and outcomes, between the pilot interventions and OzHarvest’s FEAST program was particularly noticeable in those schools that featured both during the term. Healthy eating programs from NSW Department of Health might also be worth considering partnerships with.
- *Maintains a strong focus on monitoring and evaluation* adapted from this pilot program. This would involve pre and post-student surveys, and post-teacher and parent interviews as previously run. Pre and post-photo audits would be expanded into more comprehensive approaches that measure volume and weight, and involve students. Parent surveys would not be included in favour of 2-3 parent post interviews conducted per school.