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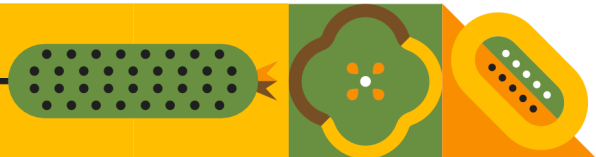


Ayuntamiento
de Murcia

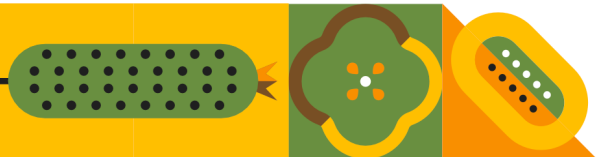
MANUAL FOR REDUCING FOOD WASTE IN THE CITY OF MURCIA.

CASE STUDY OF PRIMARY EDUCATION SCHOOLS



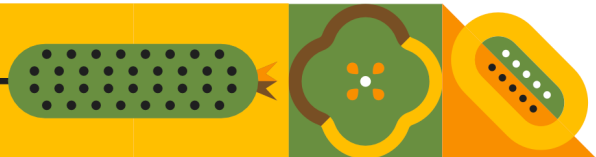


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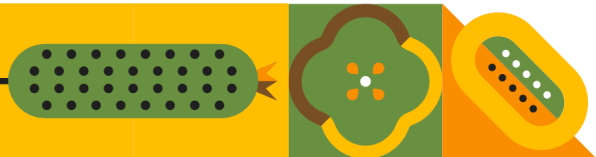


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0. Executive Summary

Food waste in school canteens is a significant but highly addressable problem. The analysis carried out in the municipality of Murcia within the framework of the European project LIFE GREENME5 demonstrates that most of the waste generated does not stem from structural failures in the system, but rather from factors related to consumption, service organisation and the adaptation of food offerings to pupils.

Based on the diagnosis conducted across six educational centres, waste is found to be concentrated mainly in plate leftovers, with between 70% and 90% being potentially avoidable. This finding shifts the focus of intervention away from logistics or storage, and towards the consumption experience in the school canteen.

The project highlights three key ideas:

- The school canteen is not merely a food service, but an educational space with the capacity to generate behavioural change.
- Reducing waste requires coordinated action across the entire value chain, from menu planning to waste management.
- There are quick-to-implement, low-cost measures that can deliver immediate results, alongside more structural ones that consolidate change over the medium and long term.

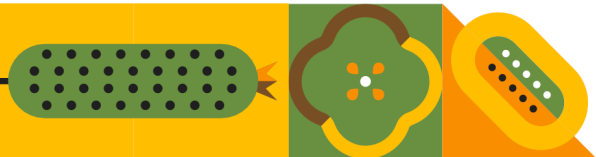
Drawing on these findings, specific strategies have been designed for each centre, structured around eight areas of intervention (menus, purchasing, storage, production, consumption, reuse, waste and awareness-raising), with a shared approach based on prevention, measurement and shared responsibility among the stakeholders involved.

As a complementary measure, the awareness-raising campaign has helped bring these messages to the educational community and the general public, reinforcing the connection between the school environment and domestic habits. This combined approach has proven key to generating sustainable change over time.

Factors such as the absence of measurement systems, limited menu adaptation and the insufficient integration of the canteen as an educational space undermine the effectiveness of the system and contribute to waste generation.

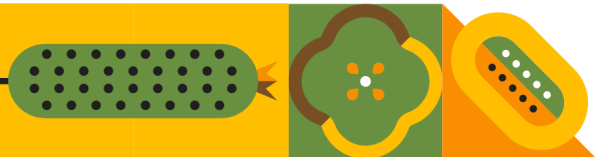
Against this backdrop, clear lines of action are identified:

- Incorporating waste measurement as a standard management tool
- Strengthening menu adaptation to the pupil profile
- Improving consumption conditions (timing, environment, organisation)
- Promoting circular public procurement as a driver of change
- Integrating awareness-raising as a structural component of the service



The experience developed in Murcia demonstrates that reducing food waste in school canteens is technically feasible, operationally manageable and socially necessary, and that it can generate environmental, economic and educational benefits simultaneously.

The proposed model has a high replication potential, provided its core approach is maintained: rigorous diagnosis, context adaptation and active participation of the stakeholders involved.



1. Introduction and Context

1.1. The LIFE GreenMe5 Project

The LIFE GreenMe5 project is an initiative funded by the European Commission under the LIFE programme, aimed at facilitating the implementation of the Green City Accord in five European municipalities: Arezzo (Italy), Cieza and Murcia (Spain), Vilnius (Lithuania) and Helsingborg (Sweden). The project is coordinated by the Federation of Municipalities of the Region of Murcia (FMRM), and also counts with EuroVertice as a partner specialised in environmental governance.

The project is built on inter-city cooperation, promoting the exchange of experiences, the strengthening of technical capacities and the identification of common solutions to urban environmental challenges, acting as a shared learning platform to advance towards more sustainable models.

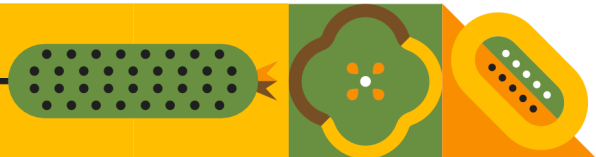
Its approach is structured around the five pillars of the Green City Accord: air quality, water quality, biodiversity and green spaces, noise pollution, and circular economy and waste management, which guide the design of actions in each municipality.

Within this framework, the Murcia City Council, a signatory to the Green City Accord since 2021, participates with an approach focused on the circular economy, particularly on the prevention of food waste in school canteens. This participation combines technical analysis, the development of prevention strategies and training and awareness-raising actions, in line with European policies such as the Farm to Fork strategy. This participation has resulted in the present manual, deliverable D5.2 "Manual for reducing food waste in Murcia", corresponding to work package 5 within the European project LIFE22-GIE-ES-LIFE GreenMe5, project number 101113893, drafted by the Murcia City Council.

Overall, LIFE GreenMe5 is configured as a project aimed not only at improving local environmental indicators, but also at generating transferable knowledge, promoting collaborative governance and driving the transition towards more sustainable, healthy and circular cities.

1.2. Commitment of the Murcia City Council

The Murcia City Council maintains a firm commitment to urban sustainability and the circular economy, aligned with European environmental strategies. This commitment is reinforced by its accession to the Green City Accord in 2021, driving improvements in areas such as air quality, water, green spaces and waste management.



Within the framework of this agreement, the circular economy and, in particular, the prevention of food waste have become priority lines of action, with special attention to primary school canteens.

Participation in the LIFE GreenMe5 project enables progress in evidence-based policies and the implementation of concrete actions, which include:

- Conducting diagnoses through audits in educational centres.
- Designing reduction strategies tailored to each context.
- Fostering collaboration between schools, businesses, social organisations and public administration.
- Developing training and awareness-raising actions.

The City Council also acts as a facilitating agent, promoting cooperation among actors across the food chain to advance towards more sustainable and efficient models.

1.3. Conceptual Framework

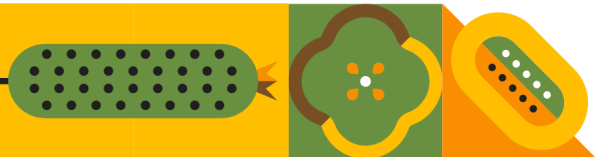
This manual is based on a conceptual framework that enables a comprehensive understanding of food waste, analysing its causes, impacts and possible lines of action from the perspective of sustainability and the circular economy.

Food waste is defined as food that is fit for human consumption but does not end up being consumed. This project pays particular attention to waste generated at the consumption stage in school canteens, including both food that is not served and food that is prepared or served but not consumed. It is a complex phenomenon, influenced by logistical, organisational, cultural and behavioural factors.

From a circular economy perspective, food waste is interpreted as an inefficiency of the food system, in which resources such as water, energy, land and labour are squandered. This approach calls for a shift towards a model based on waste prevention, optimisation of food use, redistribution of surplus food and recovery of organic waste, advancing towards more sustainable food systems.

In terms of its impacts, food waste has effects across three main dimensions: environmental, by increasing emissions and resource consumption; economic, by generating losses throughout the food chain; and social, by highlighting the inefficient management of resources in a context of food vulnerability.

The project is aligned with the European Farm to Fork strategy, which promotes a fairer, healthier and more sustainable food system, encouraging waste reduction, short supply chains and responsible consumption habits.



Within this framework, school canteens are considered a key space for intervention, both for their educational capacity to build habits from an early age and for their operational relevance. They combine service management improvement measures with awareness-raising and education actions targeting the educational community.

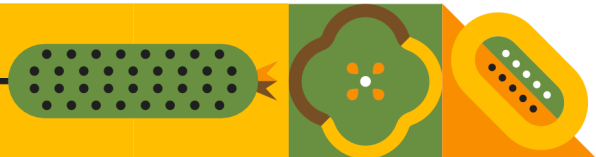
1.4. Regulatory and Strategic Framework

The prevention of food waste is a priority of European public policies within the framework of the European Green Deal, which drives the transition towards a sustainable and climate-neutral economy. The Farm to Fork strategy reinforces this objective by promoting waste reduction throughout the entire food chain.

At the regulatory level, Directive 2008/98/EC, as amended by Directive (EU) 2018/851, establishes the waste hierarchy, placing prevention as the top priority and promoting waste reduction, food donation and the recovery of surplus food.

In Spain, this framework is developed primarily through Law 7/2022, which promotes the circular economy and waste prevention, including food waste, and Law 1/2025, focused specifically on the prevention of food losses and food waste throughout the entire chain, establishing obligations such as prevention plans, donation of surplus food and more sustainable practices in the food sector.

Taken together, this European and national framework reinforces the transition towards a more efficient and circular food system, within which the LIFE GreenMe5 project operates through concrete and replicable local actions.



2. General Project Methodology

The methodology of the LIFE GreenMe5 project in the municipality of Murcia has been designed with a comprehensive approach, combining quantitative and qualitative tools to address food waste from an applied, participatory and action-oriented perspective. This approach has made it possible not only to diagnose the situation, but also to identify viable and transferable solutions for other contexts.

2.1. Methodological Approach

Participatory Methodology

The project has been based on a participatory methodology involving the different actors in the food chain, recognising that food waste is a complex problem that requires collaboration among multiple stakeholders.

In this regard, direct engagement has taken place with:

- Educational centres (management, teaching staff and pupils)
- Catering companies and kitchen staff
- Canteen supervisors
- Social organisations (food banks, NGOs, social canteens)
- The productive sector (fruit and vegetable industry)
- Public administrations

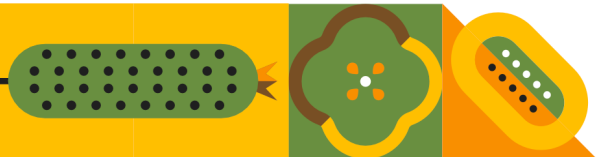
The active participation of these actors has been channelled through in-depth interviews, surveys, training sessions and dialogue spaces, which has made it possible to incorporate different perspectives, identify real barriers and build solutions adapted to the local context.

Systemic Approach to the Food Chain

The project adopts a systemic approach, analysing food waste throughout the entire value chain, from production and procurement through to final consumption and waste management.

This approach has made it possible to:

- Identify critical points where waste is generated
- Analyse the interrelationships between the different actors
- Detect inefficiencies in logistical, organisational and consumption processes
- Propose integrated solutions that address the problem at its source



In the specific case of school canteens, the analysis has not been limited to the moment of consumption, but has also covered aspects such as menu planning, food preparation, service, pupil behaviour and surplus food management.

2.2. Work Structure

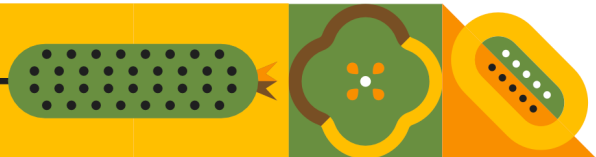
The methodological development of the project has been structured around two main work packages:

- **Food waste audit and diagnosis [work package 5 (WP5)]:** Focused on the detailed analysis of the situation in educational centres, including the conduct of audits, the preparation of diagnoses, the design of reduction strategies and the generation of technical knowledge (guides, reports and manuals).
- **Communication and awareness-raising campaign [work package 7 (WP7)]:** Aimed at disseminating results and raising public awareness, through informational, training and outreach actions, as well as the design of supporting materials.

Both work packages have operated in a complementary manner, integrating the knowledge generated through the diagnosis with awareness-raising and behavioural change actions.

The project has been carried out in several sequential and interrelated phases:

1. **Methodological design phase:** Definition of tools, indicators and data collection protocols.
2. **Diagnosis phase:** Data collection through audits, surveys and interviews, both in educational centres and at municipal level.
3. **Analysis phase:** Processing and interpretation of the information collected, identification of causes and critical points.
4. **Intervention phase:** Design and implementation of food waste reduction strategies, as well as training actions.
5. **Awareness-raising and dissemination phase:** Development of the communication campaign targeting the general public and the stakeholders involved.
6. **Synthesis and transfer phase:** Preparation of final documents (guides, manuals, reports) and systematisation of results for replication purposes.



2.3. Tools Used

Audits

Audits have been a central tool of the project, enabling the collection of detailed and quantifiable information on food waste in educational centres.

A specific audit model has been applied, structured across several levels:

- **Characterisation of the educational centre**, through a form gathering information on the type of centre, canteen organisation, type of catering service, menus and awareness-raising policies.
- **Sensory and perception evaluation**, through differentiated questionnaires addressed to pupils, canteen supervisors and kitchen staff, analysing aspects such as food quality, behaviour during meals, satisfaction and the causes of waste.
- **Direct observation of the service**, through questionnaires for audit staff assessing the functioning of the canteen, the presentation of dishes, environmental conditions and existing protocols.
- **Quantitative measurement of waste**, based on the differentiated weighing of waste generated at different stages (storage, preparation, service and plate leftovers), over a minimum period of five days.

This system has made it possible to obtain indicators such as waste per diner, the types of food most frequently wasted and the associated causes.

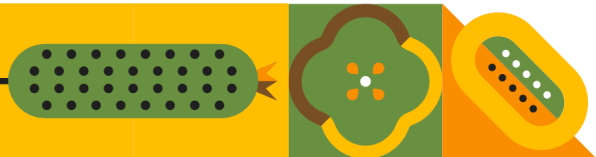
Surveys

Surveys have been developed targeting the general public to gather information on consumption habits, perceptions of food waste and levels of awareness. These surveys have made it possible to broaden the diagnosis beyond the school environment, incorporating a municipal perspective.

Participatory Dynamics

The project has incorporated various participatory dynamics, including:

- **In-depth interviews** with social organisations, the fruit and vegetable sector and regional authorities, to identify barriers, opportunities and specific needs.
- **Collaborative analysis tools**, such as the use of journey maps, which have enabled the visual and participatory identification of critical points.
- **Delphi questionnaires**, addressed to experts and key stakeholders, to gather qualitative assessments and reach consensus on possible courses of action.

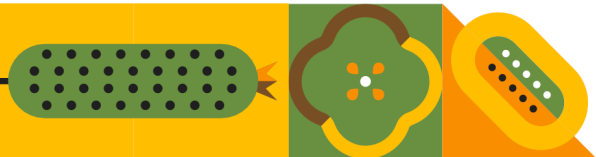


Indicators

Both quantitative and qualitative indicators have been defined and used to assess the scale of food waste and the impact of the actions carried out, the most notable of which are:

- Total amount of food waste (kg overall and per diner)
- Types of food wasted
- Percentage of avoidable waste
- Level of satisfaction with the canteen service
- Participation in training and awareness-raising actions

These indicators have enabled project monitoring, results evaluation and the establishment of a solid basis for decision-making and the replication of actions.



3. Diagnosis of Food Waste in the Municipality of Murcia

Food waste is one of the main environmental, economic and social challenges in the field of urban sustainability. In the municipality of Murcia, it manifests particularly in the domestic sphere, although it is also present in other links of the food chain, with significant impacts on resource use, waste generation and associated emissions.

Within the framework of the European Project LIFE GREENME5, a municipal diagnosis has been produced with the aim of identifying behavioural patterns, quantifying trends and guiding prevention actions.

This diagnosis is based primarily on the results of the citizen survey on food waste in households, complemented by an approach to estimating waste by sector and to food inflows to the municipality.

The analysis of this information makes it possible to characterise the population's food purchasing, consumption and management habits, identify behavioural patterns and critical points of waste generation, and detect opportunities for improvement. It also provides an integrated view of the local food system, which is key to designing effective interventions aligned with the circular economy and prevention at source.

3.1. Municipal-Level Diagnosis

The diagnosis of food waste in the municipality of Murcia is based primarily on the results of the survey on household habits and behaviours, which constitutes a direct source of information on the everyday reality of citizens in relation to food purchasing, consumption and management. As a complementary element, this analysis has drawn on a review of specialised literature and related technical documentation, which has made it possible to contextualise the results obtained, cross-reference trends and enrich the interpretation of the phenomenon from a broader perspective.

The survey, with a sample of 149 residents from different neighbourhoods and districts of the municipality, provides a representative view of domestic behavioural patterns and social perceptions around food waste. The results offer a solid basis for identifying general trends, as well as the main factors influencing the generation of food waste in the domestic sphere.

In summary, the main results of the municipal diagnosis can be structured around three broad areas of analysis:

- **Results of the citizen survey**

The analysis of the survey on food waste in households in the municipality of Murcia reflects a scenario characterised by high social awareness of the problem, alongside the persistence of certain food consumption and management habits that generate waste in the domestic sphere.

Regarding purchasing and consumption habits, most households shop frequently, with 83% purchasing food at least once a week, mainly at supermarkets or hypermarkets (92.5%). However, meal planning is only partial, as only 34% always plan their menus or follow shopping lists, while 56.5% do so occasionally. This lack of systematic planning, combined with the fact that almost a third of households acknowledge buying more food than needed, is one of the main structural factors associated with the generation of surplus food.

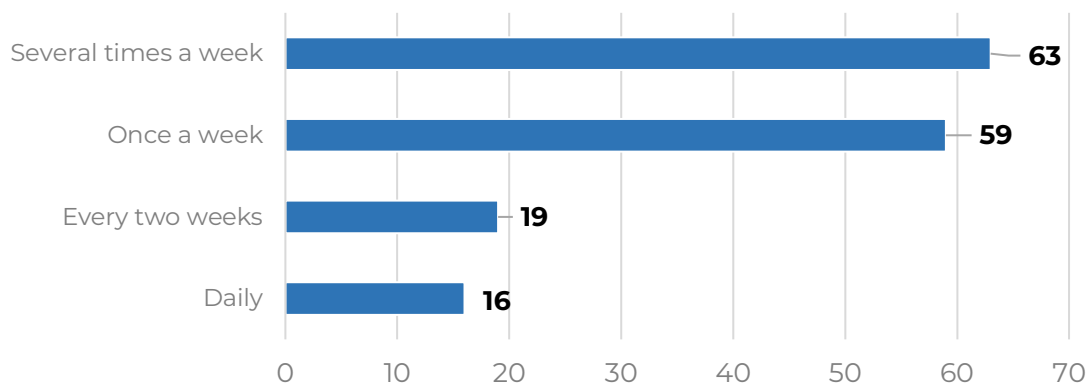


Chart 1. Shopping frequency.

In terms of perception and willingness to change, a high level of social awareness of the problem stands out, with 85.7% considering food waste an important problem and more than 90% expressing interest in receiving tools or training to reduce it. In this regard, citizens identify education in the family and school environment, together with improved practical information on food storage and reuse, as the main lines of action.

A widespread culture of reuse is also evident, reflected in the adoption of practices such as consuming leftovers, freezing food or reusing it in new preparations, as well as a high level of knowledge about the difference between "use-by date" and "best before date" (89.8%). These dynamics show that the problem lies not so much in a lack of knowledge as in the systematic application of good practices in daily life.

The survey data are available in the reference document included in the bibliography: '*Results report: Survey on food waste in households*'.

- **Estimation of food waste by sector**

The sectoral analysis of food waste in the municipality of Murcia makes it possible to differentiate the relative contribution of the main links in the food chain: the domestic sphere, the hospitality and food service sector, and food retail. Consistent with data from the Ministry of Agriculture, Fisheries and Food, through the food waste quantification panel, the household is confirmed as the main point of food waste generation, accounting for more than half of the national total, which reinforces its role as a priority area for intervention.

In the case of the domestic sphere, the survey results allow for a deeper understanding of the nature of waste, showing that it is concentrated particularly in fresh food and already-prepared meals, pointing to problems related to planning, storage and the use of surplus food. In this context, 45% of households acknowledge generating waste on a weekly basis or more frequently, confirming the relevance of the phenomenon in everyday life. Furthermore, the main causes identified — food deterioration (68.8%), expiry (14.5%), preparation of excessive quantities (11.6%) and lack of planning (5.1%) — allow for a more precise characterisation of the origin of the problem in the domestic environment.

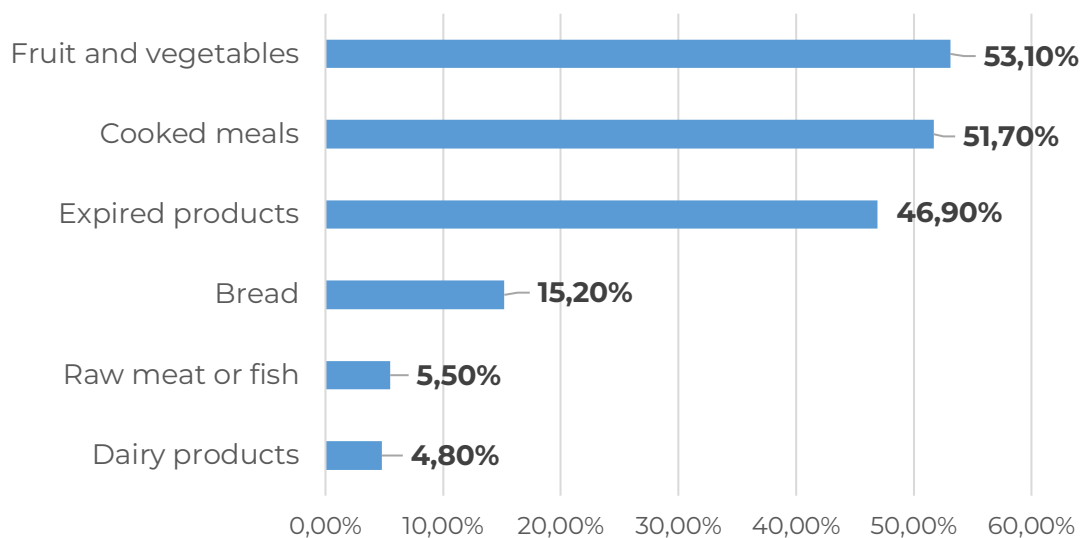
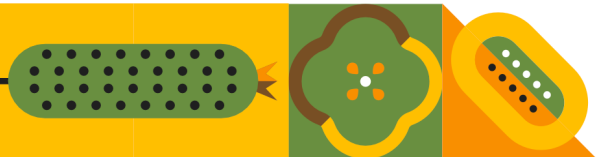


Chart 2: Most wasted foods.

The hospitality and food service sector shows a different pattern, in which waste is generated primarily during food preparation and from unconsumed leftovers. Although its overall weight is lower than that of the domestic sphere, it is a relevant sector due to its capacity to influence consumption habits. In this regard, the practice of taking away leftovers outside the home is beginning to be partially integrated into citizens' habits, with 78.2% of respondents stating that they take restaurant leftovers home always or on some occasions.



Food retail, for its part, concentrates its contribution to waste in stock management, the rotation of fresh products and the withdrawal of items close to their consumption date. Although its relative weight within the food system is smaller, it plays a key role in prevention through strategies of logistical efficiency, surplus reduction and food redistribution.

Taken together, the sectoral analysis shows that the greatest potential for reducing food waste in the municipality of Murcia is clearly concentrated in the domestic sphere, where both the largest share of waste and the main improvement factors identified in the survey converge, such as partial purchase planning, storage management and the systematic use of food. Nevertheless, effective reduction of food waste requires coordinated action throughout the food chain, integrating the hospitality and retail sectors as complementary actors in the transition towards a more efficient and sustainable model.

- **Food inflows to the municipality**

The flow of food entering the municipality of Murcia is a key structural element for understanding the availability, diversity and volume of products reaching households and the various consumption actors.

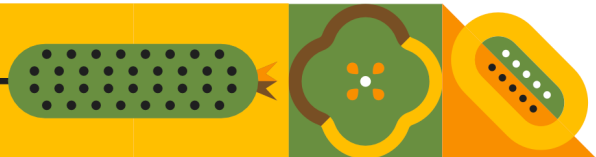
The municipality, as a reference urban centre, is supplied through a food distribution network characterised by a combination of large retail outlets, wholesale markets, specialised retail trade and logistics channels linked to regional and national distribution. This structure guarantees a broad and continuous supply of products, although it may also favour consumption patterns based on abundance and permanent availability.

High food accessibility, combined with the diversity of purchasing formats and commercial promotions, directly influences citizens' purchasing habits, in some cases encouraging the purchase of larger quantities than needed or the acquisition of products close to their consumption date without sufficient prior planning.

In this regard, food inflows to the municipality not only determine food availability, but also indirectly shape waste dynamics, by interacting with purchasing, consumption and domestic food management habits.

3.2. Diagnosis in School Canteens

The diagnosis of food waste in school canteens has been developed from the analysis of six educational centres, with the aim of gaining a detailed understanding of how food waste is generated, managed and distributed in this context. This process has made it possible to characterise both the conditions under which the canteen service is provided and the consumption patterns of pupils, combining quantitative and qualitative information. Through



this approach, the main factors influencing waste generation have been identified, as well as the critical points on which it is necessary to intervene in order to improve the efficiency of the system and advance towards more sustainable management models.

The following is a summary of the information gathered from the six diagnoses conducted, which can be consulted as part of the internal bibliography of this manual.

3.2.1. Description of the Participating Centres

The diagnosis has been carried out in six primary education centres in the municipality of Murcia, selected as case studies within the LIFE GREENME5 project. The centres analysed show a high degree of heterogeneity in terms of size, number of diners, type of service and organisational characteristics, which makes it possible to obtain a representative view of the different realities within the municipal school canteen system.

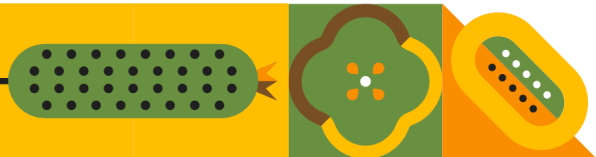
In terms of size, the centres range from single-form schools with a small number of pupils (around 85 students and approximately 40 diners) to large centres with 689 enrolled pupils and 460 daily canteen users. These are served by two catering companies (SERUNIÓN and Antonia Navarro).

EDUCATIONAL CENTRE	COMPANY	Total pupils / diners
CEIP José Martínez Tornel	SERUNIÓN	185 / 35
CEIP Mariano Aroca López	SERUNIÓN	689 / 460
CEIP Ntra. Sra. De Cortes	SERUNIÓN	85 / 40
CEIP Ntra. Sra. del Carmen	ANTONIA NAVARRO	374 / 182
CEIP San Pío X	SERUNIÓN	160 / 51
CEIP Santiago el Mayor	SERUNIÓN	416 / 240

Table 1: Number of diners per centre and catering company.

Different profiles of canteen-using pupils are also identified, including centres with a high percentage of scholarship-supported pupils — in some cases where all users hold a scholarship — which introduces relevant social variables into service management and consumption habits.

From an organisational standpoint, the centres show different levels of development in canteen management: some have consolidated structures such as canteen committees or periodic monitoring systems, while in others, management falls primarily on the school leadership without specific formalised bodies.



Taken together, the sample analysed makes it possible to identify common patterns and specific features that influence both the generation of food waste and the opportunities for improvement in its prevention.

3.2.2. Characterisation of the Canteen Service

The analysis of the six centres reveals the coexistence of different canteen service delivery models, both in terms of food preparation and service organisation and consumption conditions.

Kitchen and supply model

Two main types are identified:

- **On-site kitchen**, in which food is prepared entirely on the school premises, present in several of the centres analysed. This model allows for greater flexibility in menu adaptation and portion adjustment.
- **Hot-line catering**, where food is prepared in a central kitchen and transported to the school for service, with limited assembly operations on site. This system presents greater constraints in terms of flexibility and control over presentation.

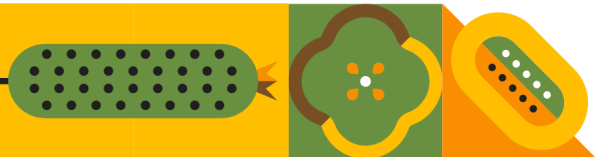
EDUCATIONAL CENTRE	KITCHEN AND SUPPLY MODEL
CEIP José Martínez Tornel	Hot-line catering
CEIP Mariano Aroca López	On-site kitchen
CEIP Ntra. Sra. De Cortes	On-site kitchen
CEIP Ntra. Sra. del Carmen	On-site kitchen
CEIP San Pío X	Hot-line catering
CEIP Santiago el Mayor	On-site kitchen

Table 2: Kitchen and supply model.

Service organisation

The organisation of the canteen varies significantly between centres:

- **Number of sittings:** ranging from centres with a single service sitting to others with three differentiated sittings according to pupil age.
- **Service duration:** the effective eating time generally ranges between 25 and 45 minutes.



- **Supervision ratios:** these are adjusted to regulations according to pupil age and needs, with greater supervision intensity in early childhood stages and for pupils with special educational needs.

Canteen spaces and conditions

The physical conditions of the canteen are a determining factor in the consumption experience:

- Some centres have specific and suitable spaces designed as a school canteen.
- In other cases, the service takes place in spaces not originally designed for this purpose, such as adapted classrooms, which creates problems with noise, comfort and organisation.
- Even in purpose-built canteens, acoustic and coexistence issues are identified, particularly in centres with a high density of pupils.

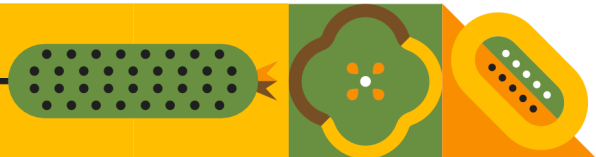
Service and consumption system

Service is mostly provided using:

- **Individual compartmentalised trays**, which facilitate portion control and the identification of special diets.
- In some cases, **particularly for early childhood pupils, single-use containers** are used.



Chart 3: Individual compartmentalised trays.



The degree of pupil autonomy is generally limited, mainly restricted to basic tasks such as clearing trays and depositing them in the appropriate containers, particularly for older pupils. In other situations, the service is carried out under the supervision and support of canteen supervisors, who play a significant role in managing the consumption process.

Food offer and menu management

All the centres analysed provide:

- Menus adapted to allergies and intolerances
- Specific options (pork-free, halal, special diets, etc.)
- Regular communication with families about menus

In some cases, the food offering incorporates locally sourced products, which contributes positively to the freshness and quality of food, potentially encouraging acceptance by pupils and therefore reducing waste. This practice also helps reduce losses associated with deterioration during transport, by shortening distribution times and conditions. However, this practice is not widespread nor systematically structured as a specific food waste reduction strategy.

On the other hand, a limited systematic adaptation of menus to pupil preferences is detected, which directly influences waste generation, particularly in the form of plate leftovers.

Waste management and awareness-raising

In general terms, it is observed that:

- There is no systematic quantification of food waste, except within the framework of the audit.
- Waste management is carried out mainly by depositing waste in general waste containers, with few recovery initiatives (composting or donation).
- The presence of differentiated containers and signage is limited or non-existent in several centres.
- Educational actions related to food waste are sporadic and unstructured, being integrated into broader health or healthy eating programmes.

3.2.3. Quantitative Results

The quantitative analysis of food waste in the six educational centres has been carried out on the basis of measurement campaigns spanning 10 school days, making it possible to obtain comparable and representative data on the actual operation of the canteen service.

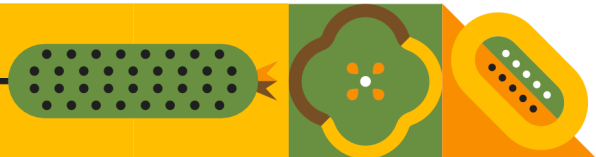
In general terms, the results reveal high variability in the total amount of waste generated, closely linked to the size of the centre and the number of diners. Values ranging from an average of 3.57 kg/day to 73.65 kg/day are observed.

CENTRE	TYPE OF WASTE	UNITS
CEIP Mariano Aroca López	Average daily total waste:	73,652 kg/day
	Average daily total waste / pupil:	0,160 kg/day
CEIP Ntra. Sra. Del Carmen	Average daily total waste:	20,783 kg/day
	Average daily total waste / pupil:	0,114 kg/day
CEIP Santiago El Mayor	Average daily total waste:	42,657 kg/day
	Average daily total waste / pupil:	0,178 kg/day
CEIP José Martínez Tornel	Average daily total waste:	6,562 kg/day
	Average daily total waste / pupil:	0,187 kg/day
CEIP Ntra. Sra. De Cortes	Average daily total waste:	3,573 kg/day
	Average daily total waste / pupil:	0,089 kg/day
CEIP San Pío X	Average daily total waste:	11,572 kg/day
	Average daily total waste / pupil:	0,226 kg/day

Table 3: Average daily total waste.

Total waste is distributed across the following categories:

CENTRE	TYPE OF WASTE	TOTAL WEIGHT (KG/DAY)	POTENTIALLY AVOIDABLE WASTE (KG)
CEIP José Martínez Tornel	Spoiled or deteriorated food	0	0
	Waste during preparation	2,90	1,36
	Plate leftovers	3,66	3,64
	TOTAL	6,56	5,01
CEIP Mariano Aroca López	Spoiled or deteriorated food	0	0
	Waste during preparation	9,52	5,06
	Plate leftovers	64,13	51,55
	TOTAL	73,65	56,60
CEIP Nuestra Señora de Cortes	Spoiled or deteriorated food	0	0
	Waste during preparation	1,40	0,19
	Plate leftovers	2,18	1,82
	TOTAL	3,57	2,01



CENTRE	TYPE OF WASTE	TOTAL WEIGHT (KG/DAY)	POTENTIALLY AVOIDABLE WASTE (KG)
CEIP Nuestra Señora del Carmen	Spoiled or deteriorated food	0,14	0,14
	Waste during preparation	7,59	1,99
	Plate leftovers	13,05	11,00
	TOTAL	20,78	13,12
CEIP San Pío X	Spoiled or deteriorated food	0,47	0,47
	Waste during preparation	2,21	1,85
	Plate leftovers	8,90	8,05
	TOTAL	11,57	10,37
CEIP Santiago el Mayor	Spoiled or deteriorated food	0	0
	Waste during preparation	5,99	4,62
	Plate leftovers	36,67	27,06
	TOTAL	42,66	31,68

Table 4: Waste generated during the measurement period.

Beyond total volume, the most significant figure is the proportion of potentially avoidable waste, which reaches very high values in all the centres analysed. In absolute terms, this waste ranges from approximately 2 kg/day to more than 56 kg/day, representing in most cases between 70% and 90% of the total generated.

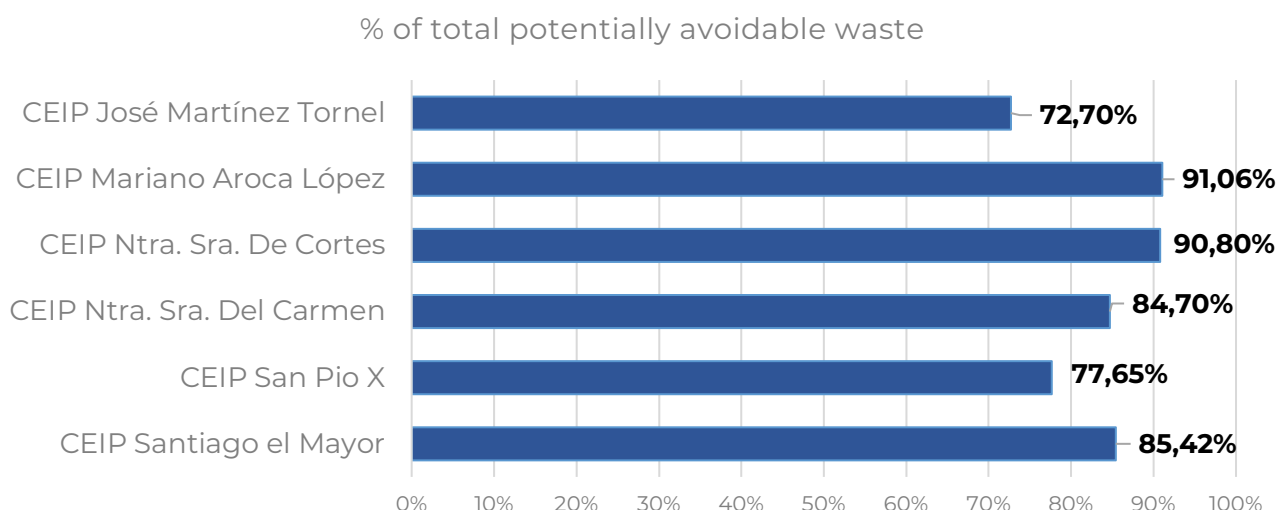


Chart 4: % Potentially avoidable waste.

Regarding the distribution by process stage, a common pattern is identified across all centres:

- **Plate leftovers:** these constitute the main source of waste, accounting for between 55% and 87% of the total, and concentrating the largest share of avoidable waste.

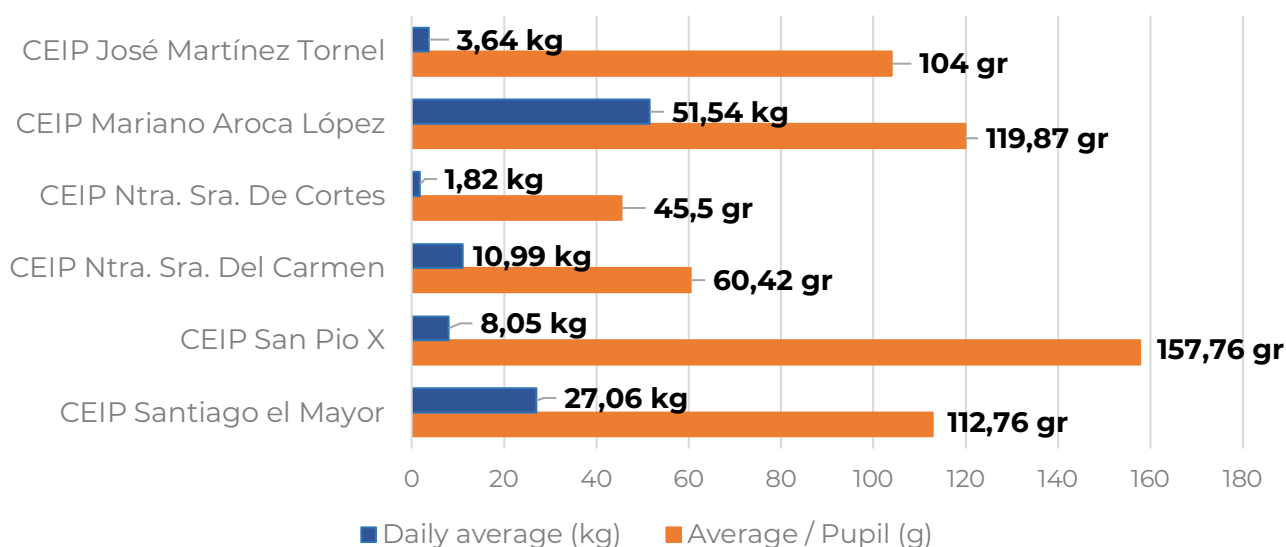


Chart 5: Weight of plate leftovers by centre.

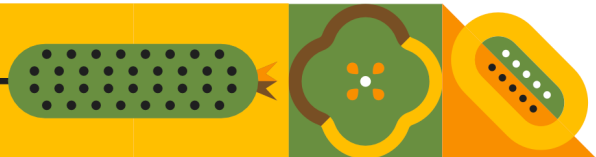
- **Preparation waste:** accounts for a smaller percentage (between 12% and 44%), largely associated with inedible fractions (peelings, bones, etc.).
- **Spoiled or expired food:** has a practically negligible incidence in most centres.

From these charts it can be drawn that:

- The weighted average of avoidable waste across the 6 centres is: **105.06 grams/pupil**
- The total avoidable waste per day across the 6 centres is: **103.1 kg/day**

A relevant aspect identified during the audit process is the difference between the number of expected and actual diners, which directly influences waste generation. In several centres, daily deviations arising from uncommunicated absences are detected.

These differences create a mismatch between the amount of food prepared and the amount actually consumed, leading to the appearance of surpluses during service (cooked dishes). The introduction of more accurate forecasting systems and daily update mechanisms is identified as a key line of improvement for optimising planning, as well as the implementation of internal reuse mechanisms or donation to reintegrate those prepared dishes into the food chain, which in some cases may exceed 60 portions.



A comparative table between expected and actual diners during the measurement period is provided below:

CENTRE	AVERAGE DIFFERENCE IN DINNERS	PEAK DEVIATIONS
CEIP José Martínez Tornel	-5,1 diners (actual < expected)	-10 diners
CEIP Mariano Aroca López	-36,8 diners (actual < expected)	-44 diners
CEIP Ntra. Sra. de Cortes	-2,7 diners (actual < expected))	+6 diners
CEIP Ntra. Sra. del Carmen	+5 diners (actual < expected)	+11 diners
CEIP San Pío X	-2,4 diners (actual < expected)	-7 diners
CEIP Santiago el Mayor	-7,2 diners (actual < expected)	-62 diners

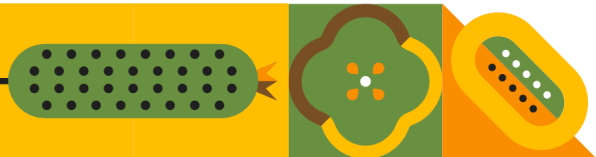
Table 5: Comparison between expected and actual diners.

Regarding the final destination of the food waste generated, it is observed that in virtually all the centres analysed, an elimination-oriented model predominates, in which waste is deposited in the general waste container.

- In general: in most cases, there are no specific separate collection systems for the organic fraction.
- Recovery initiatives, such as composting or donation of surplus food, are sporadic or non-existent.
- Some internal reuse experiences are identified, both through the reutilisation of prepared dishes in other meals and through the distribution of surplus food among school staff. However, these practices are residual and unsystematic in nature, being clearly in the minority compared to the predominant elimination model.

Furthermore, from an educational standpoint, a limited presence of awareness-raising elements within the canteen space itself is detected, such as specific signage, environmental messages or nudge-type strategies to guide pupil behaviour. This absence limits the canteen's capacity as a learning space and conditions the level of awareness regarding the proper management of biowaste.

Taken together, this situation means that food waste, including that which is potentially avoidable, is not reintegrated into the system as a resource, but instead follows an elimination pathway, increasing its environmental impact and squandering its educational and social potential.



3.2.4. Qualitative Results

The qualitative analysis, based on direct observation, interviews and perception surveys (pupils, canteen supervisors and kitchen staff), makes it possible to identify the underlying factors that explain the quantitative patterns observed.

Pupil perceptions

Pupils show uneven acceptance of menus, with the main reasons for rejection identified as:

- Low acceptance of certain foods, particularly vegetables, pulses and fish
- Preference for more familiar or more palatable foods
- Lack of food education
- Limitations in daily planning, arising from variability in the number of diners

It is also observed that the canteen is perceived in many cases as a social space, where interaction with peers takes precedence over the act of eating, which influences the generation of plate leftovers.

Canteen supervisor perceptions

Canteen supervisors identify that canteen dynamics are strongly conditioned by organisational and contextual factors, with particular emphasis on:

- Managing pupil behaviour during service, in environments that in some cases present high noise levels or are not specifically designed as a canteen.
- The presentation of certain dishes, which shapes pupils' initial impressions.
- The need to balance supervision, group management and support for pupils during mealtimes, which limits individualised attention.
- The influence of the time available for lunch and the organisation of sittings on the pace of consumption.

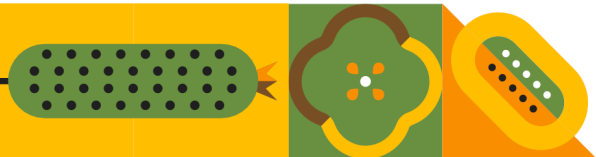
Canteen supervisors also play an active role in encouraging habits such as trying foods or finishing portions, although these actions are not usually integrated into structured food waste prevention strategies.

In some cases, the limitations detected are more related to external factors, such as the organisation or suitability of the canteen space, than to the direct actions of the staff.

Kitchen staff perceptions

Kitchen staff highlight aspects primarily related to service operations and pupil acceptance of menus, emphasising:

- Variability in the acceptance of dishes, particularly for certain food groups, which directly influences the amount of plate leftovers generated.



- The importance of factors such as food presentation, temperature and organoleptic characteristics, which can influence final consumption.
- In centres with an on-site kitchen, direct knowledge of the pupils is shown to facilitate the adjustment of portions and preparations, contributing to better adaptation of the service.

In external catering models, a reduced capacity for operational adaptation is detected, as these depend on centralised menus and processes, which limits adjustments based on pupil response.

In general, kitchen staff do not perceive waste in earlier stages as significant, with the main incidents concentrated at the consumption stage.

Organisational and social factors

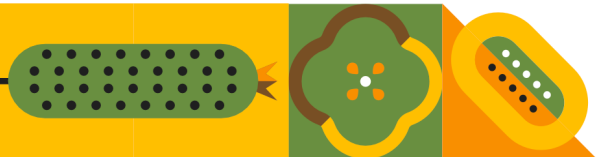
At an overall level, structural elements that influence waste are identified:

- Perception of the canteen as a welfare service rather than an educational one.
- Lack of integration of the canteen into the educational projects of the centre.
- Existence of food alternatives in the family environment, which reduces the pressure to consume the school menu.

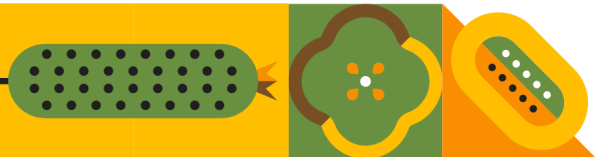
3.2.5. Critical Points Identified

Based on the combined analysis of results, several common critical points are identified in school canteens that influence the generation of food waste:

1. **High waste at the consumption stage:** The main critical point is the high generation of plate waste, which accounts for the largest share of total waste and practically all of the avoidable waste.
2. **Low acceptance of certain menus:** The lack of adaptation of menus to pupils' actual preferences, combined with issues of presentation or temperature, leads to rejection and therefore waste.
3. **Canteen space conditions:** The existence of unsuitable spaces or those with high noise levels hampers an adequate consumption experience and encourages pupil distraction.
4. **Service organisation:** Factors such as limited mealtime, the concentration of pupils in sittings or the management of supervision ratios negatively influence consumption.
5. **Lack of systematisation in prevention:** A widespread absence of structured programmes, continuous measurement systems and surplus food management protocols is detected.



6. **Weak waste management culture:** The limited presence of differentiated containers, signage and recovery strategies (composting, donation) restricts the use of generated waste as a resource.
7. **Limited educational integration of the canteen:** The canteen is not widely conceived as a key educational space for the development of food and sustainability habits.



4. Analysis of the Food Value Chain

The analysis of the food value chain in school canteens makes it possible to understand how food is generated, managed and wasted throughout the entire process, from planning through to consumption and waste management. This approach helps identify critical points, relationships between actors and opportunities for improvement. Based on the data obtained, the actors involved, the main inefficiencies and the lines of action to advance towards a more sustainable and efficient model are presented.

4.1. Actors Involved

The analysis of the food value chain in school canteens makes it possible to identify the main actors involved in the different stages of the process, from food planning and supply through to consumption and final waste management.

Educational centres

Educational centres play a central role in the organisation and supervision of the canteen service. Their main functions include:

- The administrative management of the service, including attendance monitoring, communication with families and coordination with the catering company.
- The operational organisation of the canteen (sittings, spaces, supervision ratios).
- The supervision of pedagogical and coexistence aspects during service.
- The implementation of activities related to healthy eating and, to a lesser extent, sustainability.

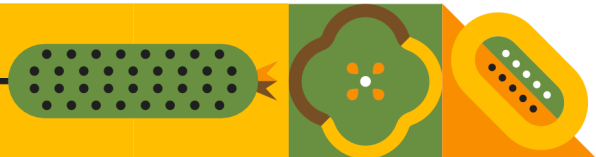
In most cases, management falls directly on the school leadership, with varying degrees of structure (with or without canteen committees or specific bodies).

Catering companies

Catering companies are responsible for the planning, preparation and supply of menus, as well as the delivery of the canteen service. Depending on the service model, their role varies:

- In on-site kitchen models, they directly manage food preparation at the school, with greater capacity for adaptation.
- In hot-line catering models, they prepare menus in central kitchens and distribute them to schools, with less scope for operational adjustment.

They also provide kitchen staff and canteen supervisors, which places them as a key actor in service quality and in the generation of food waste.



Suppliers

Suppliers are involved in the provision of raw materials and food products to catering companies or directly to schools in the case of on-site kitchens.

Their role influences aspects such as:

- Product quality and freshness
- Supply frequency
- The possibility of adjusting orders based on demand

In centralised models, this relationship is mediated by the catering company, which limits direct interaction with educational centres.

Public administration

Public administration, through local and regional bodies, acts as a regulatory, funding and promoting agent of the service, playing a key role in its configuration and quality. Its main responsibilities include:

- Defining service requirements and conditions (ratios, menus, nutritional criteria).
- Awarding contracts to catering companies.
- General supervision of service compliance.
- Promoting educational programmes and strategies linked to sustainability.

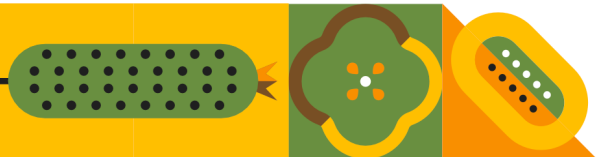
In this context, it is essential to incorporate circular public procurement criteria that integrate environmental, social and quality aspects into contracting. It is recommended not to base decisions solely on price, as this can affect service quality, menu acceptance and food waste. Within the LIFE GREENME5 project, the local administration also takes on an active role in diagnosing and improving the system, promoting more sustainable and efficient models.

4.2. Identification of Deficiencies

The analysis of the value chain makes it possible to identify a series of structural inefficiencies that contribute to the generation of food waste in school canteens.

Purchasing processes

- Difficulty in adjusting production to actual demand, particularly in centres with daily variability in the number of diners (absences not communicated in advance).
- In centralised models, limited flexibility in order planning, which restricts the capacity to adapt to incidents.
- Dependence on forecasts that do not always reflect actual consumption.



Menu management

- Limited adaptation of menus to pupil preferences, which directly affects acceptance and consumption.
- Rigidity in menus in external catering models.
- Limited systematic incorporation of information derived from actual dish acceptance into future planning.

Canteen consumption

- High generation of waste at the consumption stage (plate leftovers), this being the main inefficiency identified.
- Influence of factors such as:
 - Space conditions (noise, comfort)
 - Service organisation (sittings, timing)
 - Pupil social dynamics
- Lack of integration of the canteen as a structured educational space in relation to responsible consumption.

Waste management

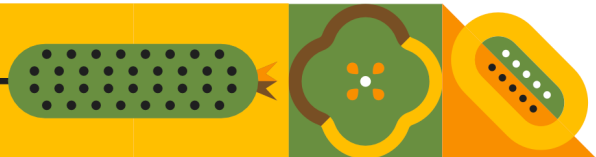
- Predominance of a direct disposal model using general waste containers, without specific separation in many centres.
- Absence of systematic waste measurement systems.
- Limited implementation of recovery strategies (composting, donation or reuse).
- Limited signage and awareness-raising regarding proper waste management.

4.3. Opportunities for Improvement

Based on the inefficiencies identified, opportunities for improvement are identified throughout the entire food value chain, structured around three main areas:

Prevention

- Improvement of portion adjustment and demand forecasting systems, incorporating actual consumption data.
- Greater adaptation of menus to pupil preferences, without compromising nutritional criteria.
- Improvement of service conditions:
 - Adaptation of spaces
 - Organisation of sittings



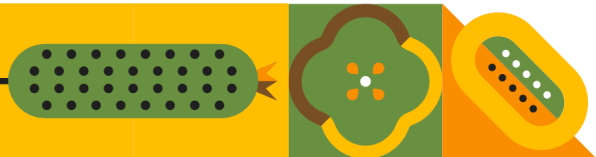
- Sufficient time for eating
- Integration of the canteen as an educational space, promoting responsible consumption habits.
- Implementation of continuous waste measurement systems as a management tool.

Redistribution

- Evaluation of mechanisms for the safe reuse of surplus food, within the applicable regulatory framework.
- Promotion of food donation initiatives where feasible.
- Improvement of internal surplus food management (reuse in on-site kitchen models).

Recovery

- Implementation or strengthening of waste separation systems at source, particularly for the organic fraction.
- Development of school composting initiatives, linked to educational projects.
- Improvement of signage and awareness-raising on proper waste management.
- Integration of recovery as part of the educational process for pupils.



5. Food Waste Reduction Strategies

Based on the diagnosis carried out in the six educational centres, food waste reduction strategies have been defined, adapted to the specific reality of each school canteen. These proposals seek to improve service efficiency and advance towards more sustainable models based on the circular economy.

The approach adopted draws on an integrated view of the food value chain, addressing all stages of the process in a coordinated manner — from menu planning to waste management — and promoting the active involvement of all participating actors. In this way, the strategies are not limited to isolated actions, but form a structured framework for action that enables progressive, measurable and sustained reduction of food waste in the school environment.

The strategies corresponding to each centre can be consulted as part of the bibliography associated with this manual: *"Strategy for the reduction of food waste"*.

5.1. Intervention Principles and Objectives

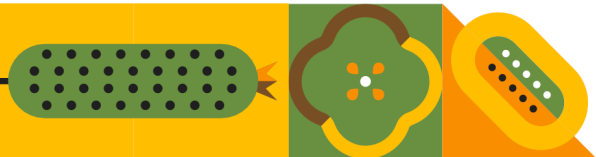
The food waste reduction strategies of the LIFE GREENME5 project have been designed on the basis of evidence and adapted to each educational centre.

The design process has been based on the results obtained from the food waste audits, which have made it possible to identify waste patterns and opportunities for improvement, and have served as the basis for prioritising actions and defining measures tailored to each context.

The strategies are underpinned by a series of common intervention principles that guide their design and implementation:

- **Prevention as the priority axis**, acting on the causes of waste before it occurs, particularly at the consumption stage.
- **Integrated value chain approach**, addressing planning, production, service and waste management in a coordinated manner.
- **Adaptation to context**, taking into account the specific characteristics of each centre in terms of size, kitchen model, pupil profile and service organisation.
- **Data-driven**, promoting measurement and continuous monitoring as key tools for decision-making.
- **Educational dimension**, understanding the school canteen as a learning space for food habits, sustainability and responsible consumption.
- **Shared responsibility**, involving all actors (educational centre, catering company, canteen supervisors, pupils and families) in waste reduction.

Within this framework, the strategies share a common overall objective, aimed at advancing towards a more efficient, healthy and sustainable school canteen model through the



progressive reduction of food waste, with particular attention to avoidable waste generated as plate leftovers.

This overall objective is developed through a set of specific objectives, the most notable of which are:

- Implementing continuous food waste measurement and monitoring systems, to provide reliable data for decision-making.
- Improving acceptance of the school menu, through the revision of menu planning, culinary techniques and food presentation.
- Optimising portion adjustment and service planning, reducing the generation of surplus food.
- Increasing food utilisation, through the development of reuse and surplus food management protocols.
- Strengthening the educational dimension of the canteen, integrating sustainability and healthy eating content into school life.
- Encouraging family involvement, promoting consistency between food habits at home and in the school environment.
- Consolidating a culture of sustainability and shared responsibility, through the definition of protocols, coordination spaces and participatory dynamics.

This methodological and strategic approach forms the basis on which the intervention axes and proposed measures are structured, as developed in the following sections.

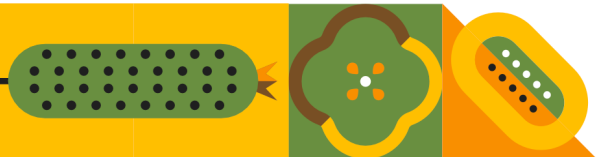
5.2. Strategic Intervention Axes

The analysis of strategies across the six educational centres makes it possible to identify common strategic axes that structure the intervention on food waste in school canteens.

These axes span the entire food value chain, from planning to waste management, and are conceived as interrelated elements. Their combined application increases the effectiveness of the measures and achieves sustained waste reduction.

5.2.1. Menu Planning

This axis focuses on planning balanced menus adapted to the pupil profile, using seasonal and versatile ingredients, promoting resourceful dishes and simpler options that facilitate acceptance. All of this contributes to increasing pupil satisfaction, reducing the amount of unconsumed food, optimising resources and promoting healthy and responsible eating habits within the school.



5.2.2. Responsible and Circular Purchasing

This axis is aimed at purchasing food according to circularity criteria, fostering relationships with local suppliers and responsible supply chains. This practice minimises the environmental footprint of school catering, reduces losses due to expiry or transport and supports the local economy, while at the same time facilitating purchasing planning that is adjusted to actual needs.

5.2.3. Efficient Storage and Conservation

This involves optimising the storage, refrigeration and conservation of food, using appropriate techniques and equipment to extend the shelf life of products. This makes it possible to reduce losses due to deterioration, ensure food quality and safety and manage stocks more efficiently, avoiding unnecessary purchases and ensuring that food is kept in optimal conditions until consumption.

5.2.4. Kitchen Preparation and Production

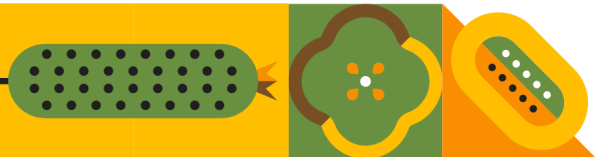
This axis seeks to plan production according to actual demand, using preparation techniques that make maximum use of ingredients and avoiding the preparation of excessive portions. In this way, waste during preparation is reduced, human and material resources are optimised and it is ensured that the food served corresponds to the actual needs of pupils.

5.2.5. Presentation and Consumption

This axis focuses on improving food presentation, adapting portion sizes, organising service efficiently and creating an attractive and pleasant canteen environment. By increasing dish acceptance and encouraging pupil participation, the amount of leftovers is reduced and a positive experience is generated that reinforces conscious and responsible consumption habits.

5.2.6. Safe Reuse of Surplus Food

Under this axis, procedures are established for the safe reuse of unconsumed food, through redistribution, alternative recipes, and similar approaches, always guaranteeing food safety. This minimises waste, encourages creativity in the kitchen and reinforces values of responsibility and solidarity within the school community.



5.2.7. Waste Management

This involves implementing selective collection systems, separation of the organic fraction and waste recovery, promoting the circular economy within the educational centre. This management reduces the environmental impact of the waste generated, promotes sustainability and provides educational opportunities for pupils on resource reuse and responsible waste handling.

5.2.8. Awareness-Raising and Educational Participation

This axis is aimed at the environmental and food education of pupils, families and school staff, encouraging their active participation and the integration of waste reduction into school projects and activities. This generates collective awareness and commitment, reinforces responsible habits and contributes to creating a school culture centred on sustainability and the stewardship of resources.

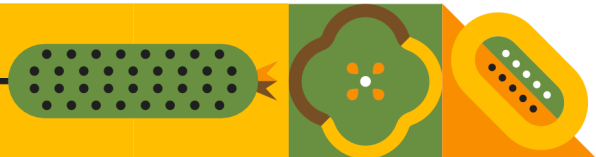
5.3. Typology of Proposed Measures

The food waste reduction strategies developed across the six educational centres have resulted in the definition of a structured measure bank, comprising a total of 53 actions organised across the 8 strategic axes, from which specific sets of measures have been drawn up for each centre.

In order to facilitate their implementation, monitoring and evaluation, the measures are presented in a standardised record format, which makes it possible to systematise the key information for each action and ensure its correct application.

Record format for measures

RECORD SECTION	DESCRIPTION / EXPECTED CONTENT
Name of the measure	Brief, clear and operational title (e.g. "Apply the FIFO rule" or "Co-created menus with pupils").
Thematic block	Indicates the block to which it belongs (e.g. "Block 3: Storage and conservation").
Main objective	What the measure aims to achieve (e.g. "Optimise food use and prevent expiry").
Description of the measure	Concrete explanation of how it is carried out, what it consists of and what resources it requires.



Target group or those responsible	Who it is aimed at or who should implement it (e.g. kitchen staff, pupils, canteen supervisors, families, management team...).
Resources required	Materials, equipment or tools needed to put it into practice (e.g. labels, scales, record sheets...).
Frequency	Whether the measure is applied on a daily, weekly, monthly, quarterly or one-off basis.
Monitoring indicators	What parameters or data make it possible to verify its effectiveness (e.g. amount of waste avoided, level of participation, menu acceptance...).
Expected benefits	Positive results anticipated (environmental, social, educational, economic).
Examples of application	Cases, experiences or specific situations showing how the measure can be implemented in different educational contexts.

Table 6: Measure record template.

The organisation of the measure bank according to the defined thematic blocks is presented below:

Axis 1: Menu planning (8 measures)

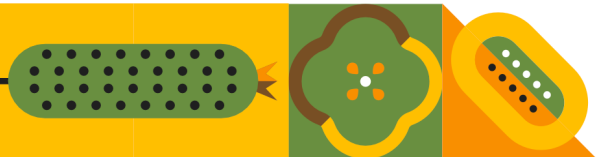
1. Design balanced menus adapted to the pupil profile
2. Incorporate versatile and seasonal ingredients
3. Periodically review dish acceptance
4. Design menus with fewer ingredients and promote resourceful dishes
5. Participatory or co-created menus
6. Improve the educational environment of the canteen
7. Adopt waste control technologies
8. Implementation of a Food Loss and Waste Prevention Plan (FLWPP)

Axis 2: Responsible and circular purchasing (4 measures)

1. Involve and train the purchasing team
2. Collaborate with suppliers
3. Prioritise circular purchasing criteria
4. Plan purchases according to actual needs

Axis 3: Storage and conservation (9 measures)

1. Maintain optimal conditions of cleanliness, ventilation and temperature



2. Inspect and maintain refrigeration and freezing equipment
3. Proper food labelling
4. Apply the FIFO rule (first in, first out)
5. Organisation of food by type and degree of processing
6. Protection of fruit and vegetables
7. Techniques that extend shelf life
8. Designation of a storeroom manager
9. Specific staff training in food handling and conservation

Axis 4: Kitchen preparation and production (8 measures)

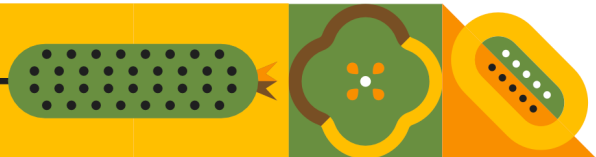
1. Adjust production to actual demand
2. Mise en place planning
3. Use of edible parts
4. Maintenance of utensils and equipment
5. Staff training in culinary techniques
6. Recording of waste generated in the kitchen
7. Use of surplus food in educational cookery workshops
8. Standardisation of dish preparation

Axis 5: Presentation and consumption (6 measures)

1. Measurement and analysis of waste in dishes and trays
2. Adaptation of the service type
3. Attractive food presentation
4. Organisation of sittings and canteen environment
5. Service and control of strategic foods
6. Quality assurance of temperature and texture

Axis 6: Reuse of surplus food (7 measures)

1. Reuse of unexposed prepared food
2. Recording of the volume of reused and donated food
3. Agreements with social organisations for donation
4. Distribution of unserved surplus food among school staff and canteen pupils' families
5. Compliance with legal and health requirements
6. Person responsible for surplus food and donation management
7. Flexible donation agreements



Axis 7: Waste management (3 measures)

1. Those responsible for collection and monitoring
2. Differentiated and labelled containers
3. Promotion of school or community composting

Axis 8: Awareness-raising and educational participation (8 measures)

1. Visual communication campaigns and actions
2. Curricular integration
3. Incentives, challenges and motivation
4. Participatory diagnoses with pupils and the school community
5. Family involvement
6. Exchange of good practices between centres
7. Citizen science experiences
8. Canteen service monitoring committee

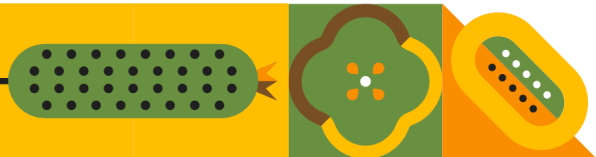
The full set of measures demonstrates that reducing food waste in school canteens requires a structured, progressive and multidimensional intervention, combining technical actions on processes with educational actions aimed at modifying habits and behaviours.

5.4. Adaptation of Strategies to the Centres

The food waste reduction strategies have been adapted to the characteristics of each centre, taking into account three key factors: centre size, kitchen model and degree of development of existing practices. This adaptation makes it possible to tailor the measures to the operational reality of each canteen.

5.4.1. Adaptation according to centre size

- **Small centres:** greater flexibility, which facilitates portion adjustment, individualised monitoring and participatory dynamics.
- **Medium-sized centres:** require greater organisation, prioritising menu planning, sitting management and kitchen-supervisor coordination.
- **Large centres:** greater complexity, and therefore control systems, standardised protocols and service organisation improvements are reinforced.



5.4.2. Adaptation according to kitchen model

- **On-site kitchen:** greater capacity for intervention, allowing portion adjustment, recipe improvement and application of kitchen reuse measures.
- **External catering:** less scope for action, so measures focus on service, consumption monitoring and coordination with the catering provider.

5.4.3. Adaptation according to degree of development of existing practices

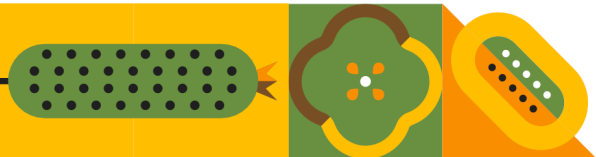
- **Centres in the initial phase:** characterised by the absence of measurement systems and specific protocols. In these cases, strategies are aimed at:
 - Implementing basic record-keeping and monitoring systems
 - Introducing initial awareness-raising measures
 - Establishing basic management protocols
- **Centres in the development phase:** have some existing practices, but these are not yet systematised. Strategies focus on:
 - Structuring and consolidating existing measures
 - Improving internal coordination
 - Incorporating new analysis and control tools
- **Centres in the consolidation phase:** have prior experience in food reuse or awareness-raising. In these cases, strategies seek to:
 - Optimise already-implemented processes
 - Deepen reuse and circular economy measures
 - Expand the educational and participatory dimension

5.4.4. Progressive implementation approach

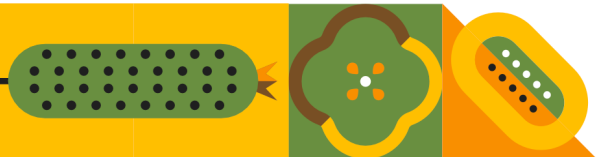
The strategies incorporate a progressive implementation approach based on the distinction between measures to "maintain" and measures to "explore", which makes it possible to structure the intervention in a realistic manner adapted to the capacity of each centre.

Measures to maintain are those already implemented or integrated into the regular functioning of the canteen and that have proven effective. They involve the consolidation of good practices, their systematisation, monitoring through indicators and continuous improvement based on available data, with the aim of ensuring their stability.

Measures to explore correspond to new actions not previously implemented, representing opportunities for improvement. They require adaptation to the centre's context, possible additional resources and, in many cases, a pilot or experimental phase. Their purpose is to



introduce innovations and advance towards more advanced models of prevention and circular economy.



6. Governance and Networking

Reducing food waste at local level requires a collaborative governance approach that goes beyond individual action and promotes networking. Within this framework, the LIFE GREENME5 project analyses the relationships between the different actors in the food system to identify opportunities for improvement in their coordination.

The system presents a potentially complementary structure between surplus food generators, social organisations with redistribution capacity and public administration as a facilitating agent. However, this complementarity does not always translate into efficient flows due to logistical, organisational and coordination barriers.

It is therefore considered essential to strengthen governance and networking to improve the connection between surplus food supply and demand, optimise resources, guarantee food safety and increase social and environmental impact at local level.

The main areas of collaboration identified are analysed below, beginning with the role of social organisations as food recipients.

6.1. Collaboration with Social Organisations

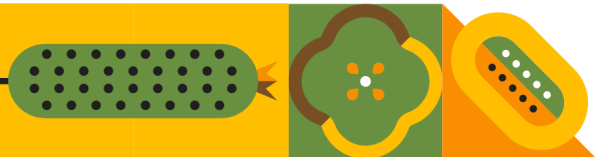
Social organisations play a fundamental role in the food recovery chain, acting as intermediary agents between surplus food generators and the beneficiary population. Their capacity to collect, manage and redistribute food makes them a key element in the development of effective food waste reduction systems.

The analysis carried out on the basis of in-depth interviews with organisations in the municipality of Murcia reveals a diverse and consolidated network, made up primarily of associations, NGOs, food banks and organisations managing social canteens. Together, these organisations serve a significant volume of people, exceeding 12,000 beneficiaries, which highlights their relevance within the local food assistance system.

Operational capacity and types of activity

The organisations present differentiated operating models, which influence their capacity to participate in surplus food redistribution:

- **Distribution organisations:** focused on delivering food for domestic consumption, with greater capacity to manage non-perishable products.
- **On-site consumption organisations:** such as social canteens, with greater capacity to manage fresh or prepared food, always under appropriate health conditions.
- **Mixed models:** combining both modalities.



This diversity allows for a degree of complementarity in food absorption, although it also introduces complexity in the management of surplus food flows.

Prior experience and willingness to collaborate

A significant proportion of the organisations have prior experience in receiving donations from various generators (supermarkets, food companies, solidarity initiatives), which provides a favourable basis for developing new lines of collaboration.

The study also reveals a high level of interest in collaborating with educational centres and other surplus-generating actors, with positive appreciation of:

- The potential for recovering food in good condition
- The strengthening of community ties
- The educational impact associated with this type of initiative

However, this willingness is conditioned by the organisations' actual capacity to manage these surpluses safely and efficiently.

Limitations and barriers identified

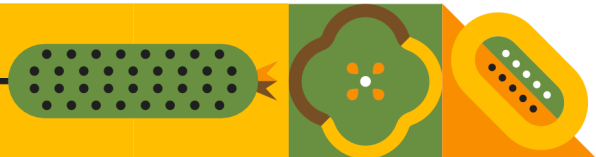
Despite the key role they play, social organisations present a series of limitations that condition their capacity for action:

- Limited infrastructure, particularly with regard to cold storage and conservation facilities.
- Logistical constraints, with variable availability of transport means and dependence in many cases on volunteer work.
- Limited capacity to manage perishable or cooked food, due to health and operational requirements.
- Rigidity in timetables and availability, which hinders the receipt of unplanned donations.
- Dependence on the operational conditions of catering companies, which in many cases do not have the kitchen resources to guarantee the safe distribution of unserved surplus food.

These limitations particularly affect the management of surplus food from school canteens, which requires speed, coordination and specific health guarantees.

Conditions for receiving food

The organisations establish clear criteria for accepting food, aimed at ensuring food safety, the most notable of which are:



- Proper state of conservation
- Adequate labelling
- Maintenance of the cold chain (where applicable)
- Delivery within appropriate timeframes for consumption or distribution

In general, there is greater willingness to receive unprocessed or packaged products, while cooked food is subject to greater restrictions.

Needs to strengthen collaboration

The analysis identifies a series of key needs to improve collaboration between social organisations and surplus food generators:

- Strengthening of storage infrastructure, particularly cold storage
- Improvement of transport means and collection logistics
- Development of structured coordination systems between actors
- Technical and training support on food safety
- Provision of financial resources to ensure the sustainability of the system

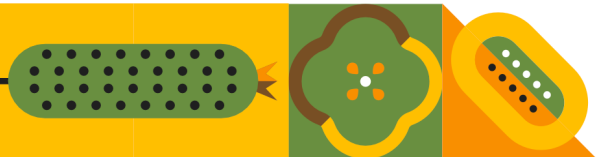
Social organisations constitute an essential pillar in the governance of the food recovery system, with a real capacity to absorb surplus food and a high level of commitment to waste reduction. However, their potential is limited by structural and logistical constraints that need to be addressed through more structured and institutionally supported collaboration models. Strengthening these organisations and integrating them into organised redistribution networks is therefore a key element for advancing towards a more efficient, coordinated and higher-impact system.

For a more detailed analysis, please refer to the associated bibliography: *Results Report on "recipient organisations"*.

6.2. Relationship with Regional Authorities

Public administrations play a fundamental role in shaping and operating the food recovery system, acting as facilitating, regulatory and mobilising agents in the relationships between the various actors involved. Their capacity to articulate policies, coordinate resources and create appropriate regulatory frameworks is key to advancing towards efficient food waste reduction models.

The analysis carried out within the framework of the project shows that public administration has relevant competences and tools in areas directly linked to the food system, such as waste management, social services, education, public health and rural development. These



competences place public authorities in a strategic position to drive integrated and cross-cutting solutions.

Level of knowledge and institutional positioning

Technical staff within public administrations recognise food waste as a significant problem, both for its environmental impact and for its social and economic implications. A growing awareness of the need to act is observed, as well as a general perception that there is room for improvement in raising public awareness and integrating the issue into public policies. However, the degree to which food waste has been incorporated into strategic planning varies, and in many cases it is partially integrated or linked to other sectoral policies, such as waste management or the circular economy, without yet having a specific and cross-cutting approach.

Administrative capacity for action

Public administrations have a range of instruments that can contribute significantly to reducing food waste and promoting the use of surplus food:

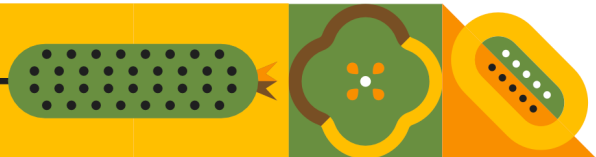
- **Strategic planning**, through local or regional waste, circular economy or sustainability plans.
- **Educational and awareness-raising programmes**, targeting educational centres and the general public.
- **Public procurement**, as a tool for incorporating sustainability criteria into canteen services.
- **Social services**, which enable food to be channelled to vulnerable populations through existing networks.
- **Technical and regulatory support**, providing guides, protocols and advice to the various actors.

These tools make it possible to act at multiple levels, from prevention to redistribution, although their effectiveness largely depends on the degree of coordination achieved.

Priority areas for intervention

Based on the analysis carried out, several priority lines are identified in which public administration can play a key role:

- **Promotion of awareness-raising and training**, through campaigns, educational programmes and actions targeting different groups.



- **Support for innovation and entrepreneurship**, encouraging initiatives aimed at the recovery of food surplus.
- **Development of technical tools**, such as guides, audits or waste measurement systems.
- **Facilitation of coordination between actors**, promoting meeting spaces and collaboration networks.

These areas allow for progress towards a more preventive and structured approach to food waste.

Institutional barriers identified

Despite its potential, the analysis highlights the existence of various limitations that affect public administration's capacity for action:

- Lack of inter-departmental coordination, which hinders a comprehensive approach to the problem.
- Difficulty in integrating food waste into existing policies.
- Resource and prioritisation constraints, which condition the implementation of new initiatives.

These barriers highlight the need to strengthen internal coordination mechanisms and to consolidate food waste as a strategic line of action.

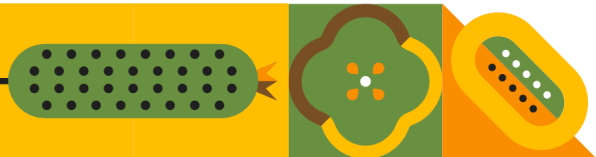
Role of public administration as a facilitating agent

Beyond its regulatory functions, public administration is configured as a key actor in activating and consolidating networking models, playing an essential role in:

- The articulation of food redistribution networks, connecting businesses and social organisations.
- The reduction of regulatory and operational barriers, providing clarity and legal certainty.
- Logistical and financial support, particularly in critical areas such as transport or storage.
- The generation of stable collaboration frameworks, through agreements, programmes or coordination platforms.

In this regard, public administration acts as the backbone of the system, enabling the transformation of a fragmented structure into a coordinated and efficient model.

The relationship with public authorities constitutes a key element in the governance of the food recovery system. Their capacity to coordinate actors, generate appropriate regulatory



frameworks and support the implementation of solutions is decisive in overcoming existing barriers and advancing towards more structured and sustainable models.

Strengthening the role of public administration as a facilitating and mobilising agent is therefore a necessary condition for consolidating effective collaboration networks and maximising the impact of food waste reduction strategies.

For further detail on the content, please refer to the internal bibliography: *Results Report "Regional Authorities"*, where the information is developed in greater depth.

6.3. Fruit and Vegetable Sector and Food Recovery

The fruit and vegetable sector constitutes a key actor within the food recovery system, acting as the main generator of surplus food at source, particularly in the form of products that are unmarketable due to aesthetic or market criteria. Its integration into waste reduction strategies is essential for advancing towards more efficient models aligned with the principles of the circular economy.

The analysis carried out within the framework of the LIFE GREENME5 project highlights that the territorial context presents particularly favourable conditions for the recovery of this surplus food, due to the existence of a consolidated fruit and vegetable sector with high productive capacity.

Generation and types of surplus food

Fruit and vegetable companies generate significant volumes of discarded product, estimated at around 5%–10% of total production, which in certain cases reach very high figures in absolute terms.

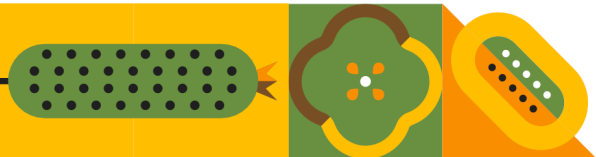
These surpluses include mainly:

- Fresh fruit (melon, watermelon, citrus fruits, pomegranate)
- Leafy vegetables (lettuce, spinach)
- Fruiting vegetables (tomato, pepper, courgette, cucumber)
- Brassicas (cabbage, broccoli)

In most cases, these products are fit for consumption, being discarded due to aesthetic, size or commercial standardisation criteria, which highlights their high potential for social recovery.

Current management of surplus food

In the current model, fruit and vegetable surpluses mainly follow low-social-impact recovery flows:



- Industrial processing
- Animal feed
- Composting or disposal

Donation to social organisations represents a minority and poorly systematised route, generally linked to one-off initiatives or informal relationships between actors.

This situation reflects a mismatch between the volume of available resources and their effective use, particularly in relation to the food waste management hierarchy, which prioritises redistribution for human consumption.

Sector capacities and limitations

The fruit and vegetable sector presents a number of strengths that favour its integration into recovery systems:

- Availability of storage and sorting infrastructure
- Capacity to generate stable volumes of product
- Existence of standardised processes that facilitate the identification of surplus food

However, significant limitations are also identified:

- Lack of specific logistical systems for donation
- Difficulty in operationally integrating the separation of product destined for social purposes
- Costs associated with transport and surplus food management
- Need for greater regulatory and operational clarity

These limitations largely explain the low implementation of structured redistribution systems.

Recovery potential and synergies

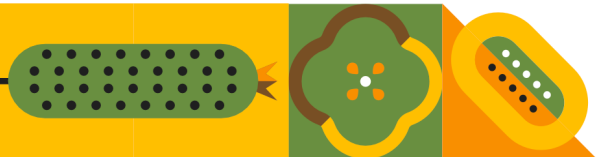
The joint analysis of the fruit and vegetable sector and social organisations makes it possible to identify a high potential for synergy between supply and demand, based on:

- The existence of surplus food at source with food value
- The real demand for food from social organisations
- The technical feasibility of redistribution flows

Fruit and vegetable products also present characteristics that favour their recovery:

- Lower health complexity compared to processed food
- Ease of handling and distribution
- High acceptance by the beneficiary population

However, their perishable nature introduces a critical variable: the need for speed and coordination in their management.



Operational requirements for redistribution

For the recovery of fruit and vegetable surpluses to be viable, it is necessary to ensure:

- **Temporal compatibility**, ensuring speed in collection and distribution
- **Logistical compatibility**, with adequate transport means and storage capacity
- **Coordination between actors**, enabling the planning and organisation of product flows
- **Compliance with health requirements**, particularly regarding traceability and conservation conditions

The absence of these elements currently constitutes one of the main bottlenecks in the system.

The fruit and vegetable sector constitutes a strategic element in food waste reduction, concentrating a significant share of available surplus food. Its integration into food redistribution networks represents a key opportunity to increase food recovery and generate social impact, provided that the logistical, organisational and coordination barriers currently in place are addressed. Further information on this area can be found in the internal bibliography: *"Results Report on Fruit and Vegetable Companies"*.

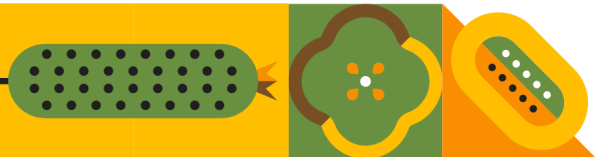
6.4. Industrial Symbiosis Report

The analysis developed within the framework of the LIFE GREENME5 project has enabled progress from a sectoral approach to food waste towards a systemic vision based on industrial symbiosis, understood as collaboration between different actors to transform surplus food into resources with social, environmental and economic value.

The report integrates information from the fruit and vegetable sector, social organisations and public administration, making it possible to identify potential synergies, existing barriers and opportunities to articulate a food recovery model at local scale.

From this perspective, surpluses are reinterpreted as underutilised resources that can be reintroduced into the system through organised redistribution circuits. The model is based on the interaction between surplus-generating companies, social organisations as recipients and redistributors, and public administration as a facilitating and coordinating agent, with the correct connection between supply and demand, with safety and traceability guarantees, being key.

The analysis reveals a high compatibility between actors, arising from the availability of surplus food, the existence of organisations with absorption capacity, the interest in participating in redistribution systems and the coordinating role of public administration.

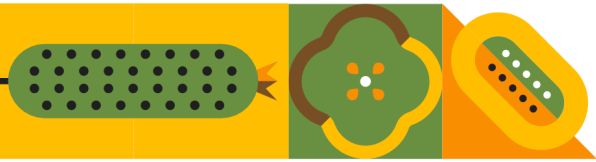


These conditions generate logistical, operational and institutional synergies that make a structured food recovery system viable.

However, significant barriers to its implementation are also identified, including logistical, regulatory and health-related, organisational, economic and cultural barriers, highlighting the need for a coordinated approach.

Based on this, an industrial symbiosis model is proposed, based on a local food redistribution network with stable coordination between actors, defined roles, structured operational flows, management tools and institutional support. Its viability depends on effective coordination, available resources, regulatory compliance, public support and the commitment of the actors involved.

Overall, the report, which can be consulted as part of the internal bibliography, concludes that the local food system has favourable conditions to advance towards a more efficient and sustainable model, provided that collaborative governance mechanisms are strengthened to overcome existing barriers.



7. Communication and Awareness-Raising Campaign

The communication and awareness-raising campaign constitutes the second pillar of the project, complementing the audit, diagnosis and strategy design work through knowledge transfer and the promotion of behavioural change around food waste.

7.1. The Role of Communication in Food Waste Reduction

Reducing food waste requires the combination of technical measures with communication, awareness-raising and training processes that make it possible to transform consumption, management and behavioural habits among all the actors involved.

For these strategies to be effective, three dimensions must be integrated:

- **Knowledge transfer**, translating the problem into accessible language.
- **Operational capacity-building**, providing tools applicable in day-to-day practice.
- **Active participation**, involving the different target groups in change.

The LIFE GREENME5 project constitutes a reference model that articulates these three dimensions through an integrated system of training, outreach materials and territorial awareness-raising actions.

7.2. Training as the Axis of Knowledge Transfer

Training is the main mechanism for converting the food waste diagnosis into concrete reduction actions.

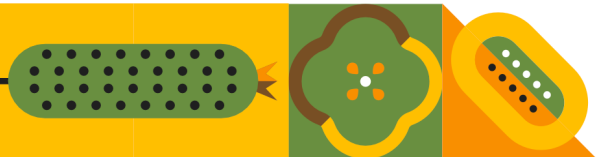
It is structured across two complementary levels: technical-operational training and teacher training.

7.2.1. Technical-Operational Training Programme

This type of training is aimed at kitchen staff, catering companies, canteen staff and educational teams, with the objective of improving food waste management in the school canteen service.

Its design should respond to three principles:

- Applied and operational approach.
- Integration of diagnostic and prevention tools.
- Direct transfer to professional practice.



Recommended content

The training programme should be structured progressively:

1. **Introduction to food waste:** Basic concepts, global and local context, regulatory framework and analysis of the impact of food waste across three dimensions: economic, social and environmental. This phase places the problem in context and builds a common basis for understanding.
2. **Diagnosis of food waste in school centres:** Tools for identifying and measuring food waste are covered, including methodologies such as waste weighing, direct observation, surveys and canteen audits. The objective is to equip participants with the capacity to quantify the problem.
3. **Preventive and corrective strategies:** Measures applicable to all phases of the food system are introduced: planning, purchasing, storage, preparation, service and waste management. The design of Food Loss and Waste Prevention Plans (FLWPP) is incorporated as a structural working tool.
4. **Participation and awareness-raising:** Strategies are developed for involving pupils, families and the educational community, encouraging shared responsibility in waste reduction and the design of participatory actions in schools.
5. **Application of nudges in school canteens:** The concept of nudges as behavioural change tools is introduced, identifying types applicable in school canteens (food presentation, space organisation, visual messages) and their integration into intervention plans.

Applied example (LIFE GREENME5)

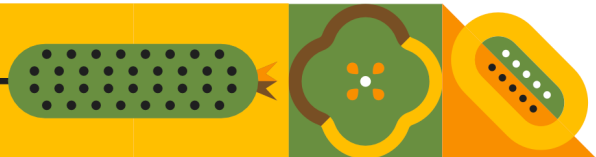
Within the framework of the LIFE GREENME5 project, a technical-operational training programme has been developed that exemplifies the application of this methodological model.

The programme had a total duration of 20 hours, combining:

- 18 hours of online training, structured in progressive theoretical modules.
- 2 hours of face-to-face session, focused on the practical application of tools.

The training was designed as a complete itinerary from diagnosis to intervention, incorporating:

- Sequential training modules on the conceptualisation, measurement and intervention of food waste.
- Practical tools for the quantification of food waste in school canteens.
- Design of prevention plans adapted to the characteristics of each educational centre.



- Application of concrete solutions in face-to-face sessions, based on real cases from school canteens.

This approach enabled not only the acquisition of knowledge, but particularly the effective transfer of food waste prevention measures to the real environment of educational centres, reinforcing the connection between training and operational change.

7.2.2. Specific Training for Teaching Staff at the Audited Centres

The involvement of teaching staff is key to integrating food waste reduction into the educational project of the school.

This type of training should be brief, practical and action-oriented.

Recommended content

- Waste reduction strategies designed for the school.
- Food waste measurement methodologies.
- Use of analytical tools such as the Journey Map.
- Application of measures in the canteen and the classroom.
- Strategies for involving pupils in habit change.

Applied example (LIFE GREENME5)

Training sessions of approximately 1 hour were conducted for teaching staff at the audited centres. These sessions focused on:

- The explanation of strategies designed specifically for each centre,
- The introduction to food waste measurement tools,
- The use of analytical frameworks such as the Journey Map to identify critical points,
- And the definition of concrete actions for application in the day-to-day life of the classroom and the canteen.

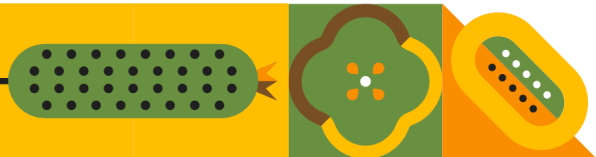
This format enabled a rapid transfer of the strategies to the real educational context.

7.3. Awareness-Raising and Citizen Participation Actions

Reducing food waste requires taking the message beyond the school environment, incorporating citizens as active agents of change.

7.3.1. Talks and workshops in neighbourhoods and districts (62)

Awareness-raising actions should bring the problem closer to everyday life through participatory formats.



Recommended structure:

- Explanation of the food waste problem.
- Practical tips applicable in the home.
- Spaces for reflection and personal commitment.

Applied example (LIFE GREENME5)

62 face-to-face actions were carried out in neighbourhoods and districts of the municipality. These sessions were structured in three blocks:

- An introductory talk on the scale, causes and impacts of food waste, addressing its environmental, social and economic dimensions.
- A "life hacks" block, with practical recommendations for reducing food waste at home (purchase planning, food conservation, use of leftovers).
- A "green coaching" space, focused on reflection on personal habits and the adoption of improvement commitments.

This format made it possible to combine information, practice and behavioural change in a single intervention.

7.3.2. Habits survey

Awareness-raising actions should be complemented by social diagnostic tools that make it possible to:

- Analyse food purchasing, consumption and management habits.
- Identify the level of knowledge about food waste.
- Detect barriers and opportunities for change.
- Guide future awareness-raising actions.

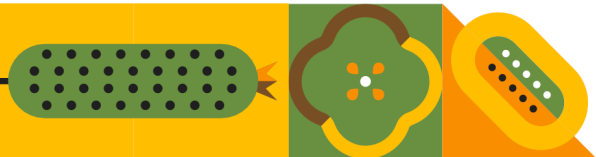
Applied example (LIFE GREENME5)

A food habits survey aimed at the general public was designed and implemented, making it possible to:

- Obtain direct information on domestic behaviours,
- Analyse the level of awareness about the problem,
- And complement the technical diagnosis carried out in educational centres.

7.4. Design and Production of Outreach Materials

Outreach materials are essential for ensuring the continuity of the message and facilitating its understanding.



7.4.1. Thematic guides

Thematic guides constitute one of the main instruments for knowledge transfer within a food waste reduction strategy.

Their function is twofold:

- To translate technical and regulatory knowledge into accessible language, comprehensible to different user profiles.
- To facilitate the practical application of measures, acting as reference material in educational, professional and citizen contexts alike.

To be effective, these guides must meet a series of methodological criteria:

- Clear and structured approach, adapted to each target audience.
- Practical orientation, with content applicable in day-to-day life.
- Integration of sustainability, healthy eating and circular economy concepts.
- Inclusion of tools, examples and concrete recommendations.
- Capacity to serve as reference and ongoing support material for the intervention.

Applied example (LIFE GREENME5)

Within the framework of the GreenMe5 project, two guides have been produced, aimed at different audiences and with complementary approaches:

- Guide to healthy eating and food waste reduction

This guide is aimed at the general public and seeks to connect public policies with practical actions applicable in everyday life, facilitating the adoption of responsible consumption habits.

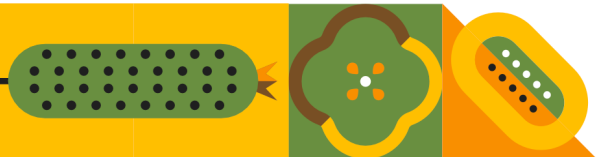
Its main characteristics include:

- Didactic and accessible approach, adapted to a general audience
- Organisation of content according to the food lifecycle (planning, production, distribution and consumption)
- Connection between public measures and good citizen practices
- Incorporation of practical tips ("eco-tips") and everyday examples

The guide addresses in an integrated manner the relationship between healthy eating and sustainability, highlighting how planning, responsible purchasing and food reuse contribute both to personal wellbeing and to reducing environmental impact.

- Training guide for food waste reduction for school canteen service workers

Aimed at kitchen staff, educational teams and canteen service professionals, this guide constitutes the reference material for the training programme developed within the project.



It is characterised by:

- Technical-operational approach
- Structured organisation in training modules
- Incorporation of practical tools (measurement, FLWPP, nudges, etc.)
- Direct application to the school canteen context

Its objective is to facilitate the implementation of concrete food waste prevention measures, as well as to improve the overall management of the canteen service.

7.4.2. Citizen awareness-raising materials

As a complement to the guides, specific materials have been developed aimed at direct communication with the general public, with a visual and easy-to-understand approach.

These materials include:

- Informational leaflets.
- High-impact visual resources.
- Key messages adapted for the general public.

Applied example (LIFE GREENME5)

Graphic materials and leaflets were produced for use in face-to-face actions, focused on messages such as the importance of reducing food waste, practical tips and environmental, social and economic benefits.

7.4.3. Educational materials

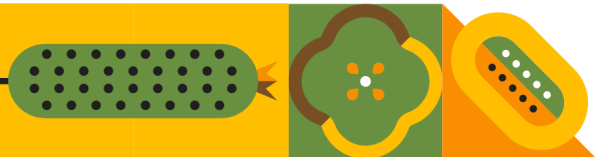
Educational resources have been developed aimed at facilitating learning, particularly in educational and training contexts.

Among these, the following stand out:

- Educational infographics.
- Games and participatory dynamics.
- Interactive digital tools (Genially, online forms).

Applied example (LIFE GREENME5)

Infographics and interactive digital resources were developed for use in both training and awareness-raising actions.



7.5. Communication and Dissemination Actions

Communication is a strategic element for amplifying the impact of actions and facilitating the transfer of results.

7.5.1. Media plan

For effective communication, it is crucial to have a media plan covering three phases:

- **Launch phase:** Aimed at publicising the project, its objectives and context. During this phase, initial dissemination actions are carried out to generate interest and place the topic of food waste on the local agenda.
- **Participation phase:** Focused on mobilising citizens and the actors involved, accompanying training actions, territorial activities and the implementation of strategies in schools. During this phase, interaction with and engagement of target audiences is reinforced.
- **Closure and results phase:** Aimed at disseminating the results achieved, good practices identified and lessons learned. This phase makes it possible to consolidate the project's impact and facilitate its transfer to other contexts.

7.5.2. Social media and digital content

Social media constitute one of the main communication channels for any project, enabling agile, direct and continuous dissemination of the content generated.

Through the usual platforms, the following can be disseminated:

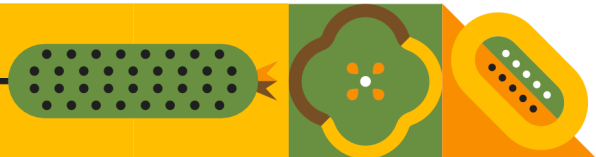
- Informational posts about food waste
- Promotion of activities and events
- Sharing of practical tips and good practices
- Showcasing of results and experiences

Content should be designed with an outreach and visual approach, adapted to different audiences and aimed at encouraging citizen interaction and engagement.

7.5.3. Organisation of Info-Days

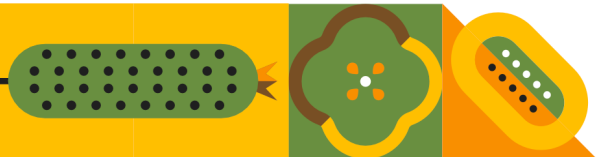
Info-Days are knowledge transfer events that typically include:

- Presentation of results.
- Dissemination of good practices.
- Participatory workshops.



Applied example (LIFE GREENME5)

Two Info-Day events were organised, aligned with Food Waste Week, as spaces for knowledge transfer, dialogue and dissemination of project results, with the participation of different actors involved.



8. Overall Project Results

The project addresses food waste from a comprehensive perspective, combining technical analysis in school canteens with awareness-raising, training and communication actions aimed at the educational community and the general public.

The integration of the audit, diagnosis and communication campaign has made it possible to obtain results both in canteen management and in consumption habits and social perception of the problem.

The results are structured around three main areas: food waste reduction, changes in habits and behaviour, and environmental, social and economic impact.

8.1. Food Waste Reduction

One of the main results of the project has been the quantification and characterisation of food waste in school canteens, which has made it possible to identify with precision the critical points of generation and the opportunities for improvement.

The audits carried out show that most of the waste is concentrated at the consumption stage, particularly in plate leftovers. A high percentage of avoidable waste has also been identified, linked primarily to the low acceptance of certain foods and to organisational aspects of the service.

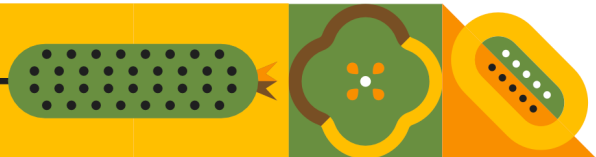
In this regard, it is estimated that between 70% and 90% of the food waste generated in the school canteens analysed is potentially avoidable, which highlights a wide margin for improvement through the application of specific measures.

In absolute terms, this potential reduction means the possibility of avoiding several kilograms of food per centre per day, which, extrapolated over the entire school year and across all centres in the municipality, implies a significant impact on waste reduction and resource optimisation.

This reduction has not only environmental implications, but also economic and organisational ones, as it contributes to lower waste management costs, improves the efficiency of the canteen service and reinforces its role as an educational space.

Based on the diagnosis, the implementation of specific strategies has made it possible to define measures tailored to each centre, incorporate waste measurement and monitoring tools and improve service planning and organisation, better aligning the relationship between production and consumption.

These results reinforce the need to intervene as a priority at the consumption stage, where the largest share of avoidable waste is concentrated.



8.2. Changes in Habits and Behaviour

The second area of results relates to changes in the habits and behaviours of the different actors involved, arising from the training and awareness-raising actions carried out.

In school canteens, greater awareness has been observed among kitchen and canteen supervisor staff regarding portion adjustment, improvements in food presentation and waste reduction, as well as the progressive incorporation of measurement and monitoring practices that support decision-making. Greater involvement of teaching staff in integrating the canteen as an educational space is also noted.

Among pupils and the educational community, awareness of food waste has improved, promoting more responsible consumption habits, particularly in food acceptance and the reduction of leftovers, alongside greater participation in educational activities.

At citizen level, the actions have contributed to increasing knowledge of the problem and encouraging more sustainable practices at home, such as purchase planning, proper food conservation and reuse, as well as creating spaces for reflection on responsible consumption.

8.3. Environmental, Social and Economic Impact

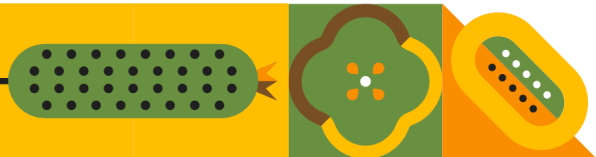
The project has generated significant impacts across the three key dimensions associated with food waste.

In the environmental sphere, the reduction of food waste contributes to decreasing waste generation, reducing greenhouse gas emissions and optimising the use of natural resources such as water, energy and land, laying the groundwork for greater efficiency in the local food system.

In the social sphere, citizen awareness and shared responsibility have been strengthened, the educational community has been involved in processes of change, opportunities for recovery for social purposes have been identified and the creation of collaboration networks between territorial actors has been encouraged.

In the economic sphere, the reduction of food waste makes it possible to optimise resources in school canteens, reduce purchasing and waste management costs and improve service efficiency, while also highlighting the potential of new economic models linked to the circular economy.

The overall results obtained demonstrate that the combination of technical diagnosis, strategy design and awareness-raising actions constitutes an effective approach to addressing food waste comprehensively. The project has made it possible not only to identify the problem, but also to activate processes of change that, if sustained over time, can generate a significant impact in environmental, social and economic terms.



9. Key Learnings That Facilitate Replication

The development of the project has made it possible to identify a set of key learnings that facilitate the replication of the model in other municipalities and educational contexts.

This section presents the main lessons, barriers and recommendations derived from the experience, with the aim of serving as a practical guide for the implementation of similar initiatives, facilitating their adaptation to different territorial contexts.

9.1. Success Factors

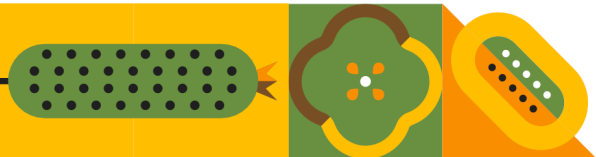
The analysis of the project's development makes it possible to identify a series of factors that have proven decisive for its correct implementation and for the achievement of results:

- **Comprehensive approach to the problem:** The combination of audit, diagnosis, strategy design and awareness-raising actions has made it possible to address food waste from all its dimensions.
- **Adaptation to the context of each centre:** The design of personalised strategies has facilitated their applicability and effectiveness, avoiding generic solutions.
- **Involvement of key actors:** The active participation of kitchen staff, canteen supervisors, teaching staff, pupils and public administration has been fundamental to the development of the project.
- **Use of measurement tools:** The incorporation of waste measurement systems has made it possible to objectify the problem and guide decision-making.
- **Integration of the educational approach:** Treating the school canteen as a learning space has reinforced the long-term sustainability of the actions.
- **Combination of training and awareness-raising:** Technical capacity-building alongside communication actions has facilitated both knowledge acquisition and behavioural change.
- **Generation of collaboration networks:** The connection between different actors (schools, social organisations, public administration, productive sector) has broadened the project's reach.

9.2. Barriers Encountered

During the development of the project, various barriers have been identified that may hinder the implementation of similar initiatives:

- **Organisational limitations in educational centres:** The lack of time, resources or structure may hinder the implementation of new measures.

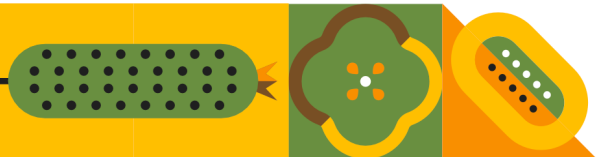


- **Resistance to change:** The modification of habits and routines, both among staff and pupils, requires progressive adaptation processes.
- **Lack of prior data:** The absence of measurement systems hinders the initial identification of the problem and the evaluation of results.
- **Limitations in external catering models:** The reduced capacity for adaptation in menu preparation limits the application of certain measures.
- **Logistical barriers in surplus food recovery:** The collection, storage and distribution of food presents operational difficulties.
- **Lack of coordination between actors:** The absence of structured collaboration mechanisms limits the development of integrated solutions.
- **Regulatory and health constraints:** Particularly relevant in the area of food donation and reuse.

9.3. Recommendations for Other Municipalities

Based on the experience developed, a series of recommendations are proposed to facilitate the implementation of similar projects in other territories:

- **Start the process with a rigorous diagnosis:** Conducting audits makes it possible to understand the starting situation and define tailored strategies.
- **Design strategies adapted to the local context:** It is essential to take into account the characteristics of the centres, the canteen model and the territorial environment.
- **Implement measurement systems from the outset:** Data collection facilitates evaluation and continuous improvement.
- **Combine technical and educational actions:** Reducing food waste requires both operational and behavioural changes.
- **Involve all actors from the beginning:** Active participation encourages the acceptance and sustainability of measures.
- **Develop practical materials and tools:** Guides, record sheets and educational resources facilitate implementation.
- **Promote institutional coordination:** Public administration should play an active role in structuring the system.
- **Encourage networking:** Collaboration between actors makes it possible to optimise resources and broaden impact.



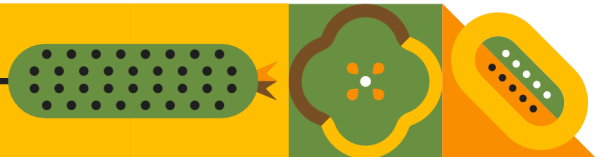
9.4. Adaptation to Different Contexts

The model developed has a high capacity for adaptation and can be implemented in different contexts with the necessary adjustments.

Some key aspects to consider in its adaptation are:

- **Type of educational centre:** Adjusting measures according to size, organisation and canteen model.
- **Territorial characteristics:** Taking into account factors such as resource availability, social structure or the presence of productive sectors.
- **Initial level of development:** Adapting the intervention according to the degree of progress in food waste management.
- **Available resources:** Scaling the actions according to human, technical and financial means.
- **Institutional and regulatory framework:** Taking into account the competences and regulations applicable in each context.

This flexible approach allows the model to be scaled and adapted, facilitating its application both in municipalities with broad technical capacity and in those with more limited resources. The experience developed demonstrates that the reduction of food waste in the school environment is an achievable objective through the application of a structured, participatory and context-adapted approach. The systematisation of learnings set out in this practical guide constitutes a useful tool for driving new initiatives and advancing towards more sustainable food models.



10. How to Implement Food Waste Reduction Strategies

The experience developed in educational centres demonstrates that the most effective actions are those implemented progressively, adapted to the reality of each canteen and with the active involvement of the entire educational community.

It is therefore recommended to approach the process through a strategy structured in different phases of work, making it possible to identify problems, prioritise actions and consolidate sustainable habits over the medium and long term.

This section offers a practical and indicative proposal for those educational centres wishing to begin a process of analysis and improvement in food waste management in their school canteens.

10.1. Initial Organisation and Planning

Before beginning the process, it is recommended to designate a person responsible or a small coordinating team tasked with organising the actions and facilitating coordination between the different profiles involved.

It is advisable to:

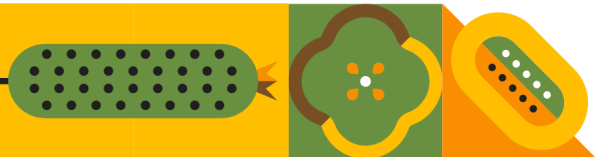
- Define initial objectives and the scope of the process.
- Identify the participating staff:
 - Management team.
 - Kitchen staff.
 - Canteen supervisors.
 - Teaching staff.
 - External canteen management companies.
 - Optionally, the following may also be included:
 - Pupil representatives.
 - Families.
- Establish a realistic work schedule.
- Inform the educational community about the initiative.

Indicative timeframe:

- 1–2 weeks of prior preparation.

Resources required

- Basic work schedule.



- Coordination spaces.
- Informational materials.
- Record-keeping and monitoring templates.

10.2. Food Waste Audit

Measurement is the foundation of any food waste prevention strategy. Without real data, it is difficult to identify problems, justify actions or evaluate improvements.

The objective of the audit is to determine:

- How much waste is generated.
- Where it is produced.
- What foods are wasted.
- What the main causes are.

It is recommended to carry out an initial audit over ten consecutive school days, as this makes it possible to obtain a representative sample of different menus and consumption patterns.

Audit preparation

Before beginning the measurement, it is necessary to:

- Designate a coordinating person.
- Explain the procedure to the staff involved.
- Prepare materials and spaces.
- Define what is to be measured and how data will be recorded.

For a basic audit, a minimum staff is recommended:

- 1 coordinating person.
- 1–2 support persons in the kitchen/canteen.
- Canteen supervisors.
- Kitchen staff.

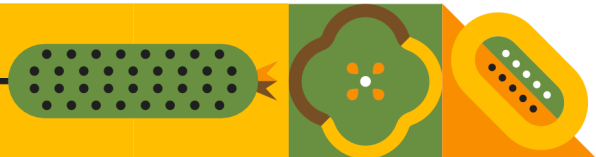
Optionally:

- Collaborating pupils.
- Teaching staff.
- Volunteer families.

Materials required

To carry out the audit correctly, it is recommended to have at least:

- Digital scales (minimum approximate precision of 10 g).



- Differentiated buckets or containers.
- Identification labels.
- Gloves and hygiene materials.
- Record-keeping templates.
- Pens or digital support.
- Camera or mobile phone for photographic records.
- Auxiliary tables.
- Calculator or spreadsheets.

Classification of waste to be measured

To obtain useful information, waste must be separated by stage and type.

a. Expired or deteriorated food

Products discarded before cooking.

Examples:

- Fruit in poor condition.
- Packaged products with damaged packaging.

Recommended information:

- Type of food.
- Approximate weight.
- Storage location.
- Cause of deterioration.

b. Waste during preparation and cooking

Non-edible waste (unavoidable)

Examples:

- Peelings.
- Fish bones.
- Bones.

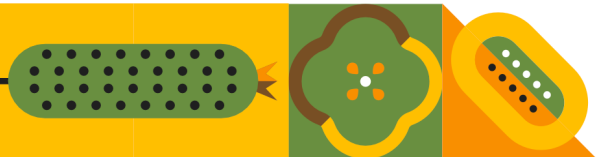
Potentially avoidable waste

Examples:

- Cooked food not served.
- Burnt or deteriorated preparations.
- Leftovers from the service line.

Recommended information:

- Type of food.



- Weight.
- Stage of the process.
- Associated cause.

c. Plate leftovers (post-consumption)

Food served but not consumed by pupils.

It is recommended to differentiate:

- Unavoidable leftovers (non-consumable, such as bones, peelings...).
- Avoidable waste (consumable food not consumed).

Useful information:

- Type of food.
- Approximate weight.
- Possible causes:
 - Low acceptance.
 - Excessive portions.
 - Insufficient time to eat.
 - Presentation or temperature issues.

d. Cooked food returned to cold storage

It is recommended to record:

- Quantity.
- Type of food.
- Planned use.
- Cause.

This analysis makes it possible to assess the potential for reuse and improvement of planning.

Recommended measurement methodology

Direct weighing

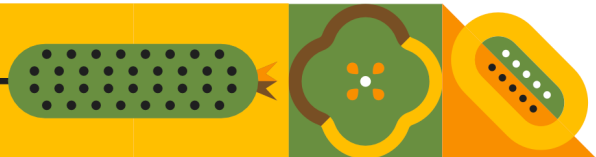
Consists of daily weighing of the waste generated at each stage.

Advantages:

- Objective and quantifiable data.
- Allows results to be compared.

Limitations:

- Requires time and organisation.



Structured observation

Makes it possible to identify:

- Pupil behaviour.
- Organisational problems.
- Dish rejection.
- Service functioning.

It is advisable for observations to be carried out by previously briefed staff to reduce subjectivity.

Questionnaires and interviews

Complement quantitative data with qualitative information.

May be addressed to:

- Pupils.
- Kitchen staff.
- Canteen supervisors.

Make it possible to understand:

- Food preferences.
- Perceived problems.
- Causes of rejection of certain dishes.

Good practices for an effective audit

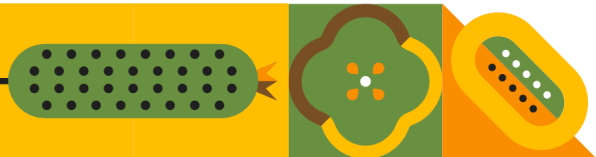
To ensure useful and viable results, it is recommended to:

- *Use simple and realistic methodologies.*
- *Maintain clear record-keeping systems.*
- *Measure over ten days.*
- *Differentiate waste by origin and type.*
- *Calculate waste per diner.*
- *Record associated causes.*
- *Involve pupils in tasks.*
- *Share the results obtained afterwards.*

Making data visible through murals, panels or infographics also constitutes a powerful awareness-raising tool.

10.3. Analysis of Results and Selection of Measures

Once the audit is complete, the centre will be able to identify:



- Main critical points.
- Types of food most frequently wasted.
- Stages with the highest waste generation.
- Organisational or acceptance problems.

Based on this analysis, it is recommended to prioritise realistic, progressive measures adapted to the functioning of the canteen. To this end, it is recommended to consult the measure bank developed as part of the GreenMe5 project.

10.4. Progressive Implementation of Good Practices

The application of measures should be approached in a gradual and coordinated manner.

It is recommended to begin with low-cost and high-viability actions, such as:

- Improvement of planning.
- Application of FIFO systems.
- Improvement of dish presentation.
- Periodic recording of food waste.
- Selective separation of waste.
- Pupil awareness-raising.

More complex actions may subsequently be incorporated:

- Composting.
- Donation agreements.
- Reuse menus.
- Advanced monitoring systems.

10.5. Monitoring and Continuous Improvement

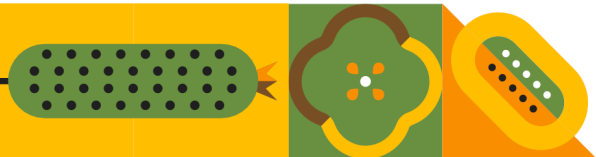
The prevention of food waste must be understood as a continuous process of improvement and learning.

It is therefore recommended to:

- Carry out periodic measurements.
- Review indicators.
- Evaluate the effectiveness of measures.
- Adjust menus and processes.
- Maintain active awareness-raising.

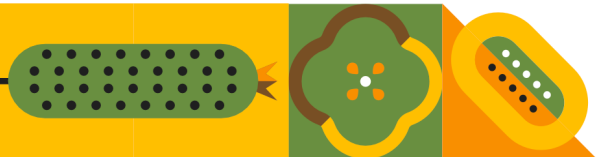
Recommended basic indicators:

- Total kg of waste.



- Kg of waste per diner.
- % of avoidable waste.
- Amount reused.
- Participation in educational activities.

The continuity of monitoring makes it possible to consolidate sustainable habits and progressively improve the efficiency of the school canteen.



11. Conclusions

11.1. Overall Summary

The project has made it possible to address food waste in the field of school canteens from a comprehensive, structured and evidence-based perspective, combining technical analysis with awareness-raising and social participation actions.

Through the development of audits, diagnoses and specific strategies in educational centres, it has been possible to precisely identify the critical points of waste generation, as well as to define concrete measures aimed at its reduction. At the same time, the communication and awareness-raising campaign has facilitated the transfer of knowledge and the involvement of the educational community and the general public, broadening the project's reach.

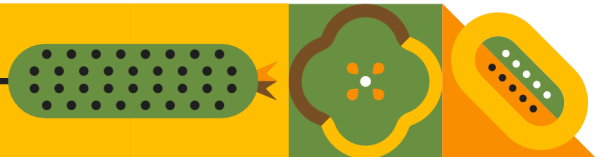
The approach adopted has made it possible not only to understand the problem, but also to activate processes of change in canteen management and consumption habits, laying the foundations for a progressive and sustained reduction of food waste.

11.2. Added Value of the Project

The project provides significant added value in several areas:

- **Integration of technical and social approaches:** The combination of audit, strategy design and awareness-raising actions has made it possible to address food waste comprehensively, going beyond partial approaches.
- **Generation of applied knowledge:** The development of guides, materials and practical tools facilitates the implementation of measures and their transfer to other contexts.
- **Adaptation to the local context:** The design of personalised strategies for each educational centre has demonstrated the importance of tailoring solutions to the operational and social reality.
- **Promotion of networking:** The connection between educational centres, social organisations, public administration and the productive sector has opened up new opportunities for collaboration and resource recovery.
- **Replicable and scalable nature:** The systematisation of methodologies and measures makes it possible to transfer the model to other municipalities and areas of action.

This set of elements positions the project as a reference experience in local food waste reduction, aligned with the principles of the circular economy and European sustainability policies.

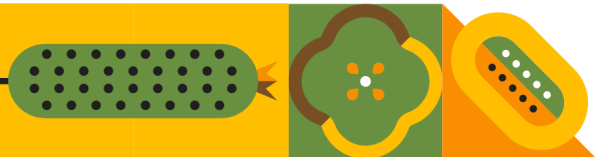


11.3. Future Lines of Action

Based on the results obtained, various lines of continuity and future development are identified:

- **Consolidation of strategies in educational centres:** Advancing in the progressive implementation of measures and in the integration of food waste into the regular management of the canteen.
- **Strengthening of measurement and monitoring systems:** Ensuring continuity in data collection to evaluate the actual impact of actions.
- **Extension of the model to new centres and municipalities:** Replicating the experience in other contexts, adapting the methodologies developed.
- **Development of food recovery networks:** Deepening the connection between surplus food generators and social organisations, advancing towards industrial symbiosis models.
- **Integration into public policies:** Incorporating food waste as a strategic line in municipal sustainability, waste or circular economy plans, as well as interpreting the strategies designed as models for the incorporation of criteria in future procurement processes.
- **Strengthening of the educational and community dimension:** Continuing to promote awareness-raising and habit change among citizens.

The project demonstrates that the reduction of food waste is a challenge that can be addressed through the combination of knowledge, planning and participation. The experience developed highlights the potential of school canteens as key spaces for driving sustainability, generating impacts that transcend the educational sphere and contribute to the transformation of the food system as a whole.



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