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Benefits and Limitations of Methods of Measuring Food Losses and Their Economic and Non-Economic Significance – The Case of Bakery and Confectionery Industry

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Abstract
The urgent challenge of reaching sustainable development goals (including those pertaining to the limitation of food losses and waste) raises social awareness in this area. At the same time, a need arose to conduct studies focusing on the creation of a system of gathering and reporting data on food wastage and procedures helping to reduce its scale. The article presents and discusses the benefits and drawbacks of selected methods of data collection used for estimating of food losses in processing sectors, based on a case of the bakery and confectionery industry (the mass balance method, quantitative studies – questionnaire/survey methods, qualitative research – in-depth interviews, direct measurement). Attention was paid to the importance of methodological, technical, organisational and legal aspects. The starting points were the methods for certain links in the food chain identified in EU legal documents of 2019. Bakery and confectionery businesses make up around 40% of the number of entities operating in the agri-food sector in Poland, holding an important place in the food economy. The sector's losses are around 2.5% of the mass of the manufactured products, with the highest losses attributable to production departments in bakeries. The complexity of manufacturing processes of a wide range of bakery and confectionery products raises numerous problems with regard to measuring losses, especially in the methodological, technical, organisational and legal aspects. The mass balance method should be considered the most recommended for measuring losses in the bakery and confectionery sector. Collected knowledge can be used on a practical level, to create reporting systems about food losses in our country for selected food sectors. Such actions will allow meeting the reporting requirements of the European Commission (EC) and to monitor process of food loss reduction.

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1. INTRODUCTION

Data collection is the most important step in market and marketing study processes. The importance of this stage stems from the major presence in the total cost and expenditure in research projects. Additionally, the methodology of data collection has a significant impact on the quality of the collected materials, consequently affecting the quality of results in a direct manner. Special challenges exist in studies conducted in companies where researchers face difficulties in accessing respondents [Kaczmarczyk 2018; Mazurek-Łopacińska and Sobocińska 2020; Xue et al. 2021].

The research and international community have actively engaged in developing the conceptual framework for food wastage studies, measuring methods and political interventions aiming to reduce it [Fabi et al. 2021; Łaba 2020]. The engaged entities unanimously point to the need of supporting public institutions in the creation of a system of collecting and reporting the relevant data, IT solutions addressing the needs of public statistics, government administration and procedures helping to prevent food waste and limit its scale. The irrational operations of market entities in this regard are cumbersome to the natural environment and fosters the excessive use of resources

and global warming. Consequently, it acts as a barrier for the sustainable operation of agri-food sectors. The method of organisation of reporting in this area in Poland will affect, among others, the possibility of estimating effects such as costs and greenhouse gas emissions. As an example, Scandinavian countries approach data collection differently, with regard to taking into account, e.g. edible food parts, product categories, food waste, usage as fodder, financial losses or donating food for social purposes [Hanssen et al. 2021]. Lost and wasted food may be expressed as a unit (mass), economic value, number or volume. In order to satisfy the requirements applying to monitoring and limiting food losses and wastage, it is necessary to have access to reliable and sufficiently detailed data that allow to specify, among others, in which food delivery chain links and for which types of products the potential to prevent and reduce is the biggest.

The scientific community [Corrado et al. 2019; Despoudi 2021; Hanssen et al. 2021] represents a view that radical changes in the functioning of the food chain caused by the drive to limit, by half, the food waste by 2030 should be considered taking into account technological, social, market and regulatory issues. Limiting food wastage may be influenced by political instruments, changes of social norms and consumer behaviours, smart technologies, new products and business models. However, to be able to efficiently recommend activities aiming to prevent food wastage, it is necessary to obtain information and data about all food that is wasted and not used for human consumption. In relation to this, studies in the Polish bakery and confectionery sector were conducted within the PROM project [Łaba and Łaba 2020], aiming to estimate the level of food losses, identify tools and methods of preventing such losses or limiting their scale [Goryńska-Goldmann et al. 2021a,b; Łaba and Goryńska-Goldmann 2020;] and determine their economic and non-economic significance. The collected data and information constitute a starting point for further initiatives and projects to reduce the losses and wastage of the sector's products at every stage of the supply chain.

The bakery and confectionery industry is the most fragmented sector in the Polish food processing industry. The sector's enterprises constitute around 40% of all businesses operating in the Polish agri-food sector, occupying a unique position in the food economy [Firlej 2013]. This notable position results, first of all, from the importance of bread products as the staple of food in the daily diet of nearly all Poles; secondly, from the fact that in the quantitative structure of consumption of cereal products by households in 2019, bread products amounted to over a half, namely around 56% (the consumption of bread products was around 35.8 kg/person/year and bread products expenses were 224 PLN/person/year) [GUS 2020b]; and thirdly, the sector's important role is seen in the number of employees (the average employment exceeds 44,500 in entities employing 50 or more staff) and the high value of sales (around PLN 8.6 billion) [estimates according to: GUS 2020a]. The sector's enterprises operating locally include bakeries, confectioneries and mixed businesses (bakery or confectionery production as the leading type), with varying organisational and legal form, scope of activity and market range, as well as different organisational culture [Goryńska-Goldmann et al. 2021a].

The purpose of the presented considerations is to present and discuss the benefits and drawbacks of selected methods of data collection used for estimating food losses in processing sectors, on the example of the bakery and confectionery industry (Fig. 2). Attention was paid to the importance of methodological, technical, organisational and legal aspects.

2. MATERIALS AND STUDY METHODS

The issue of study methods is a question about the possibilities, conditions and boundaries of exploring the reality objectively [Mazurek-Łopacińska and Sobocińska 2020]. The method for measuring food losses and wastage should be selected from the ones recommended by the European Commission, covered in a delegated act of 2019 in relation to a common method and minimal quality requirements for a uniform measurement of food waste levels. In case of food processing businesses, the recommended measuring methods are: direct measurement, mass balance, questionnaires and interviews, coefficients and production statistics, waste composition analysis (Fig. 1). The direct measurement applies to weighing or evaluating the volume of products and is performed with measuring tools. The mass balance should be understood as calculating the volume of food waste on the basis of the mass of food entering the measured system and leaving it, and on the basis of food processing and consumption within the system. The questionnaires and interviews have been widely discussed, among others by Mazurek-Łopacińska and Sobocińska [2020] and Kaczmarczyk [2018]. Production coefficients and statistics are closely related to the standards and methods of conducting production processes within companies. The analysis of waste composition is the physical separation of food waste from other fractions in order to determine the mass of separated fractions.

The paper is based on the experiences and own analyses of authors who participated in the first study of this type in Poland, conducted as a part of a research project 'Opracowanie systemu monitorowania marnowanej żywności oraz skutecznego programu racjonalizacji strat żywności i ograniczenia marnotrawstwa żywności (Development of a System for Monitoring Wasted Food and an Efficient Programme of Rationalisation of Food Losses and Limiting Food Wastage)' (Polish acronym PROM) within a strategic programme of scientific research and development efforts financed by the National Centre for Research and Development (NCBiR) [Gospostrateg1/385753/1/NCBR/2018] [Goryńska-Goldmann et al. 2021a]. There is a shortage of Polish and foreign publications accurately and definitely identifying

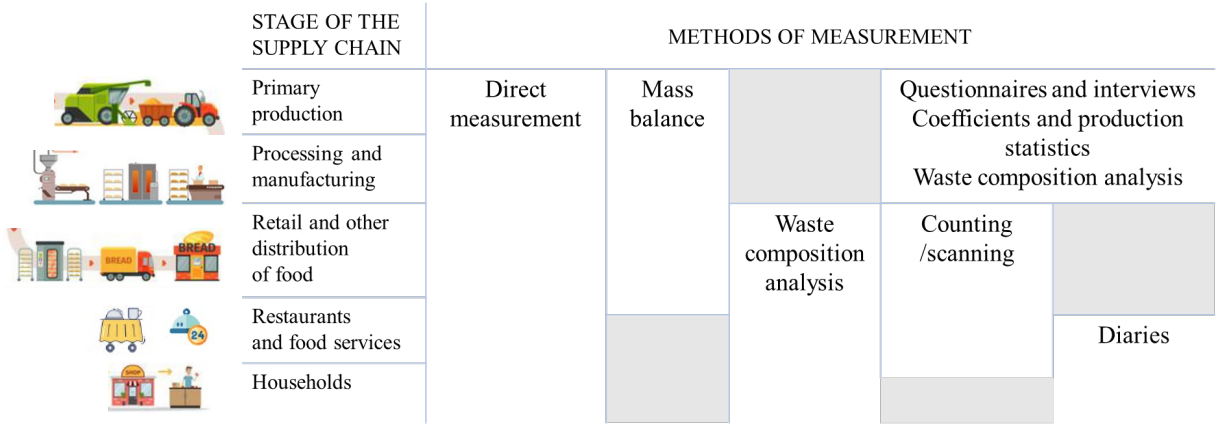


Figure 1. Methods of measuring food losses and waste recommended for particular stages of the food supply chain at the EU level
Source: ATTACHMENT III A method of accurate measurement of food losses to the Commission Delegated Decision (EU) 2019/3321 final ANNEXES 1 to 4 dated 3 May 2019 r. supplementing the Directive 2008/98/EC of the European Parliament and of the Council as regards a common methodology and minimal requirements for the uniform measurement of levels of food waste (https://ec.europa.eu/transparency/regdoc/rep/3/2019/PL/C-2019-3211-F1-PL-MAIN-PART-1.PDF ; access: 8 June 2021).

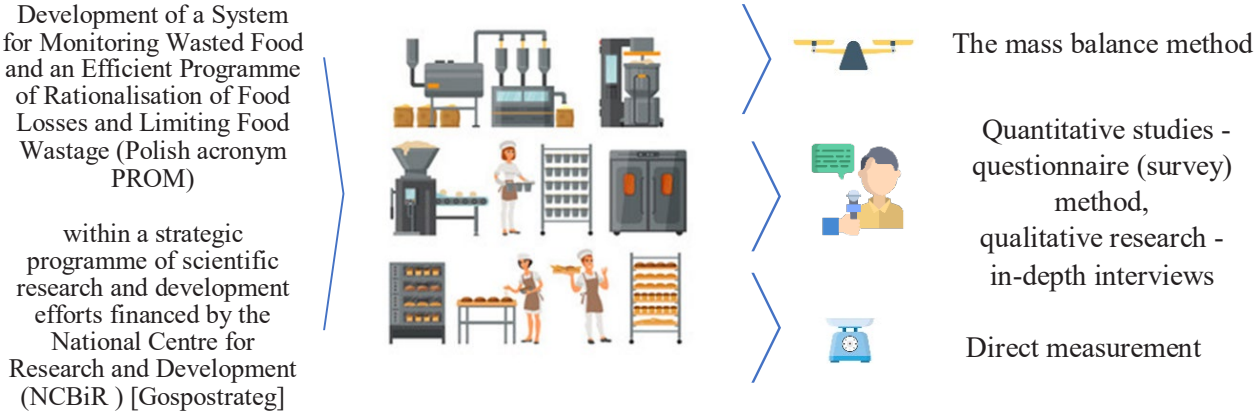


Figure 2. List of food loss measurement methods used in Polish bakery and confectionery industry
Source: own work

the usefulness of recommended methods of measuring food losses. The goal of this paper is to fill in this gap.

3. RESULTS AND DISCUSSION

3.1. Careful recruitment of examination subjects

When commencing the organisation of examinations, the sample size should be carefully selected and a sufficient number of subjects representing a given link should be approached, regardless of the accepted method. This condition is difficult to satisfy, especially in the case of quantitative examinations, and should be each time related to the nature of the examined phenomenon. Care should be taken that enterprises accepted for the study manufacture products that reflect the market's offer, belong to various economic size classes in terms of, for example, employment or production volume.
The recruitment of businesses should cover:

- sending e-mails with request to join the research project and its description;
- making phone calls (to establish contact, present goals and the process, agree date, etc.); and
- investigating organisation and institutions supporting the sector's businesses in order to request support in inviting or encouraging businesses to participate in the research project.

It is a common problem that businesses treat food losses data as sensitive information. Since businesses do not wish to disclose such data, they often ignore invitations to participate in similar research projects. Consequently, it is very important to ensure full anonymity and confidentiality to the examined entities. Organisational issues are a common reason for refusing to participate in such examinations, such as additional responsibilities, lack of time to record and collect data, unwillingness to fill in measuring logs, forms, surveys, excessive work load, insufficient number of employees and other barriers, e.g. little significance of the analysed problem.

When considering the acceptance of invitation to participate from the perspective of a business, researchers should be aware of the type and volume of effort to be made by the business tasked with providing reliable data. Depending on the accepted method of measuring losses, the following issues may be named:

- analysis, evaluation, making decisions on accepting an invitation to the research project within the scope and as determined by the researcher (difficulties applying particularly to companies with multiple production facilities and specialised businesses);
- analysing activities that must be taken by the production facility in order to reveal solutions that can be reported to the researcher;
- setting aside the time for a talk/training provided by the researcher in the company, to facilitate a constructive collaboration that leads to the assumed goal; detailed presentation of the goal by the researcher, to make sure the rationale of measurements is understood;
- the necessity to conduct a training, before the beginning of measurement, for employees responsible for recording data (among else with regard to the method of filling in forms, tables and questionnaires);
- the necessity to inform any employees delegated to taking measurements about the subject and nature of the examination, and determining the needs and directions on which relevant employees should focus on and put efforts to;
- in case of businesses with multiple production facilities, multiple departments and where such facilities (i.e. departments, branches) are located outside the company's main office, the heads or senior officers of such businesses are requested to delegate, from the quality control departments of such facilities (departments, branches), relevant employees who would be tasked, periodically, with conducting loss measurements;
- identifying and securing the necessary means of support (from senior officers, research units) for any employees delegated to perform such tasks, as well as taking into account the measurements and observations in plans;
- the necessity of providing continued support and maintaining interest of the management in conducting the measurements, in order to highlight the need and goal of the analyses;
- determining and taking into account any tasks related to the measurements in the entity's plans;
- analysing materials concerning the shaping of the quality and safety of the manufactured food to be used for purposes of accurate representation of the nature of the examined problem;
- ensuring assistance, such as from senior officers, in providing documentation and information materials when creating, e.g. measurement logs;
- ensuring the continuity of the study during the agreed time;
- collaboration between the business and the research unit with regard to maintaining care and providing assistance in streamlining the entrusted tasks; and
- conducting periodical analyses of the scale of losses in the business, divided into departments and cells within which such losses are recorded.

Drawing from the methodology of FUSIONS (2016), an EU research project, it is necessary to establish boundaries for food chain links for purposes of examining food losses and wastage. With regard to the food processing stage, it is assumed that the starting point for this link is located at the gate to the processing facility receiving the raw material. All activities performed in the production facility, which are conducted in order to obtain finished goods from input raw materials, and activities performed in the finished goods warehouse are taken into account. The end-point of the processing link is located at the gate, when the finished products are leaving the production facility. Apart from identifying phenomena at the stage of the raw materials warehouse production department or finished products department, it is important to take into account any losses originating during transport (e.g. own transport) when conducting studies within processing cells. These are losses identified from the moment the products leave the production plant until they are picked up by the wholesaler/retailer end-customer, or until such products are delivered to the company's own point of sale. Among else, this includes storage operations and the process of picking shipments. This link also includes losses stemming from incorrect agreements with suppliers or returns from retail entities.

3.2. Benefits and drawbacks of methods used for measuring food losses

The conducted examinations aiming to estimate food losses in the bakery and confectionery industry identified the benefits and drawbacks of the applied methods (Fig. 2).

3.2.1. The mass balance method

Given the lack of similar papers for the discussed sector and the lack of tools for measuring food losses in individual departments of production companies, the authors' own solution was used. Every entity received a Measurement

Log for determining losses (i.e. the scale, causes and methods of limiting them). The data were collected in a unified way, in a tabular forms. These were electronic files with tables for monitoring the mass balance throughout a predetermined number of consecutive days (seven):

- for obtaining the basic information identifying a company;
- for recording the daily consumption of all sorts of raw materials, e.g.: flour, yeast, salt, sugar, fresh eggs, eggs in powder, liquid eggs, fats, oils, additives such as seeds, dried fruit & nuts, etc., treatment agents, other bakery raw materials, including starter culture, fruit for cakes, milk and buttermilk; and
- for recording the daily mass of finished goods and individual categories of losses within three departments of a production facility:
  - ✓ production and preparation for distribution: volume of production, rejects, i.e. products failing to satisfy the in-house quality standards and other losses;
  - ✓ finished goods warehouse/forwarding: the mass of accepted goods, rejects, mass of goods for trade, mass of goods issued to employees as in-kind benefits, mass of goods left in the warehouse, other losses; and
  - ✓ transport of finished good: mass of accepted goods, mass of trade returns, other losses.

It may be necessary to have more detailed assumptions for calculating the mass balance in the entities selected for monitoring, for example with regard to:

- the method of classification of rejects (i.e. incorrectly produced finished goods, goods which cannot be reworked or which are unsuitable for reworking, in other words complete rejects);
- post-production residue left in the machinery and equipment used for productions, the so-called dirty confectionery cakes (collected from the production lines of bakeries and confectioneries in selected places);
- settling raw materials with the warehouse, taking into account any ongoing deliveries; the quantity of raw materials collected from the warehouse and their availability is important for the measurements with regard to warehouse management;
- the use of conversion rates for replacing ingredients (such conversion rates are used if one of the recipe's ingredients is replaced with another one) and the resulting quantities of raw materials;
- storage of products in the finished goods warehouse, which are manufactured two to three times per week, rather than daily;
- the volume of orders received by the production department on the day of measurement and their coincidence with the volume of sales to trade entities;
- the need to take into account that a part of remuneration is paid in kind (e.g. bread products for the bakery's employees); such practices may impact the estimation of the volume of losses and wastage in businesses between the processing cell at the level of the facility and the stock in the finished goods warehouse, leading to even more losses at the stage of production; and
- the dough yield.

The measurements were conducted separately for individual production lines/groups, namely: bread products in total, fresh dessert pastry, durable confectionery goods, pastries and other goods.

Before the start of measurements, training was provided to a senior officer responsible for the monitoring (and filling in the tables). A request was made during the training that beside the types of losses recorded in the Measurement Log's tables, the mass of all other losses is indicated as well, each time with a short explanation of the particular loss and the identification of the cause of its origin.

In order to verify and confirm that losses occur in locations indicated by bakery and confectionery managers, the documentation of food safety management HACCP system was conducted in entities that made their HACCP books available for review.

The following conclusions were made:

- measuring food losses using the mass balance method means that it is necessary to record both the mass of raw materials used in the entity and the products;
- since such records are currently taken by most companies, introducing this method may be relatively easy;
- however, it is difficult to determine the comparability of systems for recording the mass of raw materials and finished goods applies in bakery and confectionery businesses, along with the level of accuracy of measurements;
- measuring losses with this method is relatively easy and thus feasible to implement on a larger scale; and
- the popularisation of the method may lead to improved awareness of the operators in the sector and to altering the perception of the problem of food losses and wastage.

Two major organisational limitations regarding the introduction of this method were shown:

- varying practices of businesses with regard to recording the mass of raw materials and finished goods; and
- the cost of introduction of the system and the necessity of making planned, systematic and complete entries.

Another limitation applying to the correctness of estimation of losses is connected to the possibility of occurrence of errors resulting from the difference between the mass of the used bulk raw materials and the mass of finished goods, as well as to the necessity of using conversion rates.

When indicating the reasons for introducing the mass balance method, the following points should be underscored:

– the possibility of using the existing solutions for measuring the mass of raw materials and products within the implemented food safety management HACCP system;
– this benefit becomes a limitation when conducting the balance of mass in micro-businesses and in selected small companies (making up, respectively, over 77% and 21% of the sector's entities); and
– this method may be applied to companies with different production scales.

3.2.2. Direct measurement

The method consists of the identification, recording and ongoing measurement of the volume of losses. Due to the random nature of occurrence of losses, the method's application calls for the creation of an efficient recording system and maintaining a high level of efficiency of measuring devices. It is also possible that losses may be concealed in this method, e.g. by employees.
The major organisational limitations regarding the introduction of this method are:
– varying practices of companies with regard to recording losses (many companies do not record losses at all), and
– the cost of introduction of the system and the necessity to perform additional activities in entities who do not record their losses.

Other limitations may also apply to the correctness of loss estimation; this method may be accurate provided that the records are reliable and all losses are recorded.
A solid rationale for introducing this method is the possibility of integrating the direct measurement method with the mass balance method.

3.2.3. Quantitative studies – questionnaire (survey) method

Using the computer-assisted web interview (CAWI) method, respondents answer questions presented on a previously prepared website themselves. The adoption of the CAWI method depends on the premise that entities, which agree to participate in the study, are already conducting relevant activities or are aware of the existence of the problem of food losses. Consequently, they are able to determine their losses and answer the questionnaire. The common availability of IT solutions makes it possible to take advantage of the benefits of the possibility of web-based data collection. These include low costs, the convenience of conducting studies and the access to a specific group of entities with desired features (which satisfy the participation criteria). A feature of the CAWI method is relatively low response rate. As an example, a response rate of around 10% should not be treated as low. The method's main limitation comes from the difficulty in obtaining a representative sample. The examination tool should be of specialised nature and should feature internal verification mechanisms, e.g. the mass of losses at the level of causes and management should be equal. The fact that many entities will not be open to declare their losses may be a limitation. For example, Jörissen et al. [2015] draw attention to problems in obtaining reliable data from surveys conducted in Italy and Germany, resulting, among else, from the respondent's willingness to present themselves in the best possible light (also just for themselves). Ritter et al. [2015] have related the same behaviour to German companies, especially smaller ones.
Since questionnaire methods are based on declarativity, the subjectivity of entities/respondents should be accounted for. There exist problems typical for declarative methods, namely, systematical errors resulting from the lack of sufficient information about losses in the examined entity and purposeful concealment or falsification of information about losses. By principle, researchers assume that individuals providing information had already possessed this knowledge, but it is impossible to verify the source of information or the accuracy of measurement or recording of the event, namely the loss.
The limitations regarding the correctness of estimating losses using this method are connected to its sensitivity to systematic errors resulting from inaccurate recording of losses; the information about the volume of losses must come from other systems (monitoring methods). This way, the data collected via the questionnaire method are obtained with other methods, which may vary depending on the examined entities and feature different levels of errors, making it impossible to determine the precision of estimation. Additionally, call centre support (respondents may have to be contacted several times to encourage them to respond) or email support is required; these activities increase the costs and force the researcher to have an adequate data base of potential respondents, adding to organisational issues.
The fact that many entities declared no losses raises concerns. For example, this applied to around 40% responses from production departments and over half of entities when speaking of other processing stages; however, the specification of the technological process shows that a no losses situation is rather impossible.
Some of the benefits of the CAWI method are:
– it is easy to conduct (from the researcher's point of view);
– measurements are easy to conduct in businesses thanks to IT solutions;
– low level of oppression for respondents; given the lack of time, this method allows dividing the examined problem into stages/elements, which may be helpful in planning responses or incorporating them into the daily routine;
– possibility of establishing specific criteria, adequate for the needs of a given study, and obtaining data and information from entities satisfying these criteria; and
– low time consumptions (from the perspective of the entire process).

It should be noted that the limitations of the CAWI method presented above mainly stem from the method's nature itself and not from lack of willingness of the businesses to share information about losses. The declarativity

and subjectivity component should be taken into account when interpreting and making any attempts at generalising results, which may be further limited by the lack of representativity of the sample.

3.2.4. Qualitative examinations – in-depth interviews

The preceding methods presented in the approach taken by the authors determined the inclusion of the qualitative stage into the examination of food losses in processing industry, on the example of bakery and confectionery sector. This allowed an in-depth analysis of the studied phenomenon, and in particular to learn as many underlying reasons as possible.

The organisation of qualitative studies using in-depth interviews, among else with managerial staff, production department and quality control specialists, external and internal auditors operating in the bakery and confectionery sector, facilitated a better understanding of the studied subject. The collected data made it possible to identify the causes of losses, learn their scope and ways of limiting them. Speaking of the organisation of qualitative studies, their specialised subject requires the moderator in charge of the interviews to understand it well and to be trained in careful recruitment of respondents, all in order to be able to conduct such interviews in a competent manner, keeping up with the standards on the B2B market. The moderator should have a well-grounded knowledge of the specific nature of functioning of the sector and be highly skilled in conducting qualitative examinations.

The interviews were recorded and conducted subject to a standardised interview guidebook containing questions about losses, their causes and places of origin, as well as more complex issues, such as the identification of solutions implemented in the company to limit and manage losses. The analysis of in-depth reviews followed the five stages suggested by Yin [2016]:

1/ creation of a data base – transcribing the recorded interviews for further analyses;
2/ data base defragmentation – preparation of a list with codes and their respective labels, on the basis of analysis of responses; followed by assigning selected fragments of respondents' answers to the created labels;
3/ reassembly – assigning of the coded data to tabular lists;
4/ interpretation – using pivot tables to show the frequency of listing individual causes of losses by respondents during interviews; the description of in-depth reviews result is the outcome of this stage; and
5/ drawing conclusions.

3.3. Types of difficulties in the process of obtaining data about losses

Since there is no system of collecting data at a national level, as well as for individual food processing sectors, only data collected during non-exhaustive studies can be used for measuring food losses and waste.

The difficulties in obtaining the data are methodological, technical, organisational and legal. Methodological problem may arise, among else, from the lack of unified definitions or differences in data collection instruments. Reaching a relevant group of entities to ensure representativeness of results remains an important issue. Technical problems may apply to, for example, the lack of technical equipment of bakeries and confectioneries that would allow the identification, measurement and recording of losses. On the other hand, the necessity to obtain consents of individual entities for taking measurements and using the obtain data for drawing up reports is one of organisational and legal problems. Additionally, any activities related to recording the losses may be perceived by businesses as an additional hindrance to their operations. Given this background, the lack of regulations requiring businesses to record data means that they share them unwillingly.

The emotional component is yet another important element. Food wastage is a socially stigmatised problem and, consequently, food processing entities may feel apprehensive to disclose their data on losses. Such entities also tend to present themselves in a better light than in reality. The listed factors are typical for all studies, but become more pronounced when examining food losses.

3.4. Evaluation of usefulness of the used methods and recommendations

The mass balance method should be considered the most useful one of all methods applied for the analysis of losses in the bakery and confectionery sector. This is due to the fact that when taking measurements, one can draw from the existing solutions for monitoring the mass of raw materials and products within the food safety management HACCP system. Additionally, the commonness of this system translates into extensive possibilities of application and the possibility of implementation in entities with different production scales. Moreover, this method may provide high accuracy measurements. The experience gained when monitoring the mass balance in the sector's entities will make it possible to improve the proposed tool for purposes of future studies of food losses and wastage. Also, the guidelines for mass balance recording should be developed precisely and meticulously.

The method of direct measurement of losses may also be useful. High accuracy and the possibility of integration with the mass balance method also support this method. With regard to the direct measurement method, it should be remembered that the examination process itself has various limitations and is highly complicated.

The following conclusions may be drawn on the basis of experience gained when analysing food losses in the bakery and confectionery sector: 1) the specific nature of the target group determines difficulties in approaching business entities, 2) the processes of creation of losses are complex and 3) the managerial staff (e.g. production leaders, retails managers) responsible for managing the production activities have extensive knowledge. Qualitative studies methods come in handy for this

configuration of factors, allowing the researchers to investigate the topic of research more deeply and can serve as a basis to formulate recommendations for limiting food losses in the bakery and confectionery industry.

4. CONCLUSIONS

Those aiming to understand the mechanisms of generation of losses, to create procedures and propose solutions securing against them should look into combining quantitative and qualitative study methods. At the level of the processing industry, the data showing the level and causes of losses, potential waste, by-products and food wastage should be meticulously collected for individual types of operations and positions. The researchers should take into account the specific features of individual food markets and brands in their approaches, aiming to seek the most reliable and diligent ways of collecting data.
There is a need to implement systems of encouragement for businesses, or relevant regulations, so that businesses understand the need to and engage in measuring loss volumes and examining their causes and methods of limiting, with the aim to protect resources, the natural environment and the planet's inhabitants. The studies conducted in bakery and confectionery businesses revealed that many of them feared the loss of business should they make certain causes behind food losses public. The studies on food losses in the Polish bakery and confectionery sector constitute a valuable example, because of the presence of entities representing various models of functioning and market connections. These are both small enterprises, loosely connected with the market, and large, industrial bakeries with strong connections to other market players. The results of this study may be used for analyses conducted in other countries, with more homogeneous models of functioning of the industry.
Collected knowledge can be used on a practical level to create reporting systems about food losses in our country for selected food sectors. Such actions will meet the reporting requirements of the EC and monitor the process of food loss reduction.

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LEGAL ACTS

ATTACHMENT III A method of accurate measurement of food losses to the Commission Delegated Decision (EU) 2019/3321 final ANNEXES 1 to 4 dated 3 May 2019, supplementing Directive 2008/98/EC of the European Parliament and of the Council. Dostęp on-line: https://ec.europa.eu/transparency/regdoc/rep/3/2019/PL/C-2019-3211-F1-PL-MAIN-PART-1.PDF (accessed: 17 March 2021).