The quantity of small-scale onsite composting of municipal biowaste in Finland

Quality report for municipal solid waste reporting

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Abstract

The amount of biowaste treated in small-scale on-site composters (home composters) in Finland is estimated to be annually approximately 40 kg per person home composting, based on a survey in 2023. On average, 29% of Finnish citizens are using a home composter to treat their biowaste. Using a home composter is most common amongst people who live in detached or semi-detached houses. On average, 55% of population living in detached or semi-detached houses, 5% in terraced houses, and 1% in blocks of flats use home composters to treat their biowaste. Home composters are being used approximately for 10.8 months a year. The total quantity of biowaste home composted in Finland is estimated to be ca. 59,670 tonnes annually. This amounts less than 2% of the total quantity of municipal solid waste generated in 2021 in Finland. The estimate is based on survey data and includes uncertainties.

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1. Introduction

Home composting of biowaste refers to small-scale aerobic treatment of municipal biowaste in composters suitable for biowaste composting on site at the location, where the waste is produced, or near the households. Biowaste refers to biodegradable and (usually) biobased municipal solid waste fraction, kitchen waste, that is produced at households. Biowaste includes, e.g., food waste and tissue paper. Gardening waste is excluded from the scope of the survey.

The quantity of home composted biowaste is being estimated for the reporting of Waste Framework Directive by the European Union (European Union, 2018). The estimate on the quantity of home composted biowaste in Finland is also utilised in the national reporting of the recycling rate for municipal solid waste. The estimation method may also be used for other monitoring purposes, such as regional estimations.

This quality report represents the methodology for the estimation of home composted biowaste in Finland in detail. Estimation represents the year 2021, however the calculations include data from other years, in particular survey results from early 2023. The calculation has been carried out in 2023 in Finnish Environment Institute (Syke).

Calculation method and sources for information are explained in chapter 2. The estimation results, including the steps of calculation are represented in chapter 3. Finally, chapter 4 goes through the main sources of uncertainty and the conclusions.

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2. Methodology

The methodology used for estimating the quantity of home composted biowaste in Finland was developed in 2022–2023 in Finnish Environment Institute (Syke). The method is based on a study by the Ministry of the Environment that estimated the prevalence of biowaste home composting as well as the quantity of home composted biowaste in total (Teittinen, 2017).

When developing the methodology, several calculation methods were compared. The alternative methods were evaluated based on the reliability of the results and repeatability of the estimation. The estimation on the quantity of home composted biowaste has be repeatable year by year in a comparable and reliable manner. The survey results will also be regularly updated. Hence, the methodology must be as clear, simple and resource efficient as possible.

The prevalence of home composting was estimated using an extensive, national citizen survey in early 2023. In the future, home composter register information from Finnish municipalities will be used to monitor the prevalence of home composting. In addition to survey results, complementary data from national statistics was used in the estimation of the quantity of home composted biowaste.

2.1. Calculation method

According to the Waste Framework Directive, the amount of home composted biowaste is estimated using the following equation.

Equation 1. Calculation method for the quantity of home composted biowaste.

$$m_{MBWRS} = n_P \times m_{BWpp} \times q_{RS},$$

where m_{MBWRS} = the amount of home composted biowaste,
n_P = number of people home composting biowaste,
m_{BWpp} = the total amount of biowaste generated per person, and
q_{RS} = the share of home composted biowaste out of the total amount of biowaste.

The estimation must also include other factors potentially affecting the results, such as the size and type of households, collection systems, and the seasons. The Finnish estimation of home composted biowaste takes the above-mentioned factors in consideration via and follows the logic of the calculation method. The details of the national calculations are represented step by step in the following chapters.

2.1.1 Prevalence of biowaste home composting

The prevalence of biowaste home composting, or the share of population who use home composting as the main treatment for their kitchen biowaste, was studied using an extensive national citizen survey (see chapter 2.2 for more information). The prevalence of biowaste home composting amongst people living in detached or semi-detached houses, terraced houses, or blocks of flats, respectively, was separate examined. Utilising the survey results on the prevalence of home composting and the national statistics on

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population living in each house type (Statistics Finland, 2023) in 2021 in Finland, the total number of people home composting their biowaste could be estimated.

Equation 2. Calculation method for the number of people home composting biowaste in Finland.

$$n_P = q_{okpt} \times n_{P,okpt} + q_{rt} \times n_{P,rt} + q_{kt} \times n_{P,kt},$$

where n_P = the number of people home composting biowaste in Finland,
q_{okpt} = the share of people home composting biowaste out of the population living in detached or semi-detached houses,
$n_{P,okpt}$ = the population living in detached or semi-detached houses in 2021,
q_{rt} = the share of people home composting biowaste out of the population living in terraced houses,
$n_{P,rt}$ = the population living in terraced houses in 2021,
q_{kt} = the share of people home composting biowaste out of the population living in blocks of flats, and
$n_{P,kt}$ = the population living in blocks of flats in 2021.

2.1.2 Quantity of home composted biowaste

The estimation of the total quantity of home composted biowaste in Finland was carried based on a citizen survey (see further information in chapter 2.2). First, the amount of biowaste home composted per household was estimated as an average out of the survey replies (kilograms of biowaste taken to a home composter from the whole household per week). Then, the size of the household was considered for all the replies. In addition, the average operational time of the composter a year was considered. Finally, the average annual amount of home composted biowaste per person home composting could be estimated.

The average annual amount of biowaste home composted per person a year was used to estimate the total annual amount of biowaste home composted in Finland by multiplying the number of people home composting with the average amount of biowaste home composted per person.

Equation 3. Estimation of the total annual amount of biowaste home composted in Finland.

$$m_{MBWRS} = n_P \times m_{MBWRSpp},$$

where m_{MBWRS} = the total amount of municipal biowaste home composted annually in Finland,
n_P = the number of people home composting biowaste in Finland, and
$m_{MBWRSpp}$ = amount of biowaste home composted per person using home composting.

This method of calculation combines the last two terms in the above-mentioned calculation method (Equation 1), which allows using direct information from the citizen surveys as well as diminishes the uncertainties related to the estimation of the total amount of biowaste produced in households outside the official statistics or other primary data sources. There

are uncertainties related to survey data, which will be further elaborated in chapters 2.2 and 4.

2.2. Survey

The share of Finnish population home composting their biowaste and the amount of biowaste home composted were estimated based on data from an extensive national citizen survey in early 2023. The survey was carried out as a part of an EU LIFE IP funded project *Circwaste – Towards a circular economy in Finland (LIFE15IPE/FI/004)*. The survey is also a part of the national monitoring of the *Strategic Programme to Promote a Circular Economy in Finland* by the Finnish Government.

Syke was responsible for the content of the survey, but members from Ministry of the Environment, Ministry of Economic Affairs and Employment of Finland, Finnish Innovation Fund Sitra, and Statistics Finland also participated in the planning. A private business focused on surveys (Taloustutkimus oy) was responsible for the technical implementation of the survey.

An invitation letter was sent as a post card for 5,000 Finnish people, whose contact information was retrieved as a randomised sample from Digital and Population Data Services Agency's database. The target group consisted of Finnish population aged 15–86 and living in continental Finland or the Åland Islands. A push-to-web form was used, where an internet address and a QR code on the post card guided the respondents to fill in the form online. One round of reminders was sent to the target group. The survey form was available in two national languages, Finnish and Swedish, as well as in English. The instructions in the invitation letter were also available in all the three languages.

There were 975 approved replies received, with the response rate of 19.5%. The responses were analysed based on gender, age, geographic area, and house type. According to the analysis, people over 65 years old had responded somewhat more actively than others, but there were no significant differences based on gender, geographic location, or house type compared to the national distribution. Since the house type, where the respondents were living, was considered the most significant factor for questions related to home composting, weighting was not used for the data set. The data set was analysed using SPSS statistics programme. Further analyses on the survey data are elaborated step by step in chapter 3 along with the results.

3. Results

The prevalence of biowaste home composting and the total quantity of biowaste home composted in Finland was estimated based on a citizen survey and national statistics on population. The estimation results as well as data analyses and calculation steps are further elaborated in the upcoming chapters.

3.1 Prevalence of biowaste home composting

According to an extensive citizen survey carried out in early 2023, approximately 29% of the Finnish population used home composting to treat their kitchen biowaste. Home composting of biowaste was most common within residents of detached or semi-detached houses (55.4% of the residents) and rare within residents of terraced houses (4.6%) and residents living in blocks of flats (1.2% of the residents), respectively.

In the following chapters, data analyses and calculations are examined step by step.

Sorting of biowaste was a part of a more extensive question series on source-separation of different waste fractions (Table 1). The questions for each waste fraction were set compulsory. Thus, the number of respondents equal to the total number of respondents for the survey (N = 975).

Table 1. Responses to the question: "Which waste fractions are sorted in your household: Biowaste (not including gardening waste)" (N = 975).

	No. of respondents	% of respondents
1. is not sorted	131	13.4
2. is rarely sorted	46	4.7
3. is sometimes sorted	63	6.5
4. is quite often sorted	96	9.8
5. is sorted almost always	639	65.5
Sum	975	100

The respondents who selected alternatives 2–5 (Table 1, at least rarely sorted, were considered source-separating biowaste. There respondents were directed to respond to a next question on the means of collection for the sorted biowaste (Table 2).

Table 2. Responses to the question: "Where is the sorted biowaste taken in your household?" (N = 975).

	No. of respondents	Share of all respondents (%)	Share of people sorting biowaste (%)
1. Biowaste collection (a collection vehicle takes the waste to centralised treatment)	518	53.1	61.4
2. Home composter	285	**29.2**	33.8
3. Other	41	4.2	4.9
Respondents sorting biowaste	844	86.6	100
Respondents not sorting biowaste	131	13.4	
Sum of all respondents	975	100	

Respondents who selected home composter (Table 2, alternative 2, N = 285) where considered home composting their biowaste. The prevalence of biowaste home composting was examined in relation to the house type the respondents were living in. Residents of detached and semi-detached houses were grouped together, so that the grouping corresponded to the grouping used in national statistics on population (Statistics Finland, 2023). Respondents from other house types than detached, semi-detached or terraced houses and blocks of flats were excluded due to miscellaneous open answers (Table 3).

Table 3. Responses to the question: "What house type do you currently live in?" (N = 975).

	No. of respondents	% of respondents
Detached or semi-detached houses	475	48.8
Blocks of flats	352	36.1
Terraced houses	130	13.4
Others	17	1.7
Sum	975	100

The share of residents home composting biowaste, and thus the prevalence of home composting, was calculated separately for residents in each house type (Table 4).

Table 4. The prevalence of biowaste home composting was estimated by examining the responses on means of collection for sorted biowaste and the house type for each respondent.

	House type of the respondent			
	block of flats (n=338)	terraced house (n=131)	detached or semi-detached house (n=489)	other (n=17)
Biowaste collection (a collection vehicle takes the waste to centralised treatment)	90.8%	83.2%	18.6%	64.7%
Home composter	**1.2%**	**4.6%**	**55.4%**	23.5%
Other	1.2%	0.0%	7.4%	5.9%
Not sorting biowaste	6.8%	12.2%	18.6%	5.9%
Sum	100%	100%	100%	100%

The total number of people home composting biowaste in Finland was estimated using the national statistics on population per house type in 2021 (Statistics Finland, 2023) and the prevalence on biowaste home composting within residents of each house type (Table 5). Altogether, ca. 1.5 million Finnish citizens are home composting their biowaste. Majority of the home composting population lives in detached or semi-detached houses.

Table 5. The prevalence of biowaste home composting and the population home composting biowaste in Finland.

House type	Population in 2021	Prevalence of home composting (% of residents in each house type)	Population home composting biowaste
Detached and semi-detached houses	2,592,936	55.4%	1,436,487
Terraced houses	716,451	4.6%	32,957
Blocks of flats	2,047,482	1.2%	24,570
Sum	**5,356,869**		**1,494,013**
Source	*Statistics Finland (2023)*	*Finnish Environment Institute (2023, not published)*	

3.2 Quantity of home composted biowaste

The quantity of home composted biowaste per person composting was, according to a survey carried out in 2023, ca. 850 grams a week, when the composter was in use. The composters were in operation on average 10.8 months a year, or 90% of the year. Thus, the average amount of biowaste one person took to a home composter was ca. 40 kilograms a year. Altogether, the total quantity of biowaste home composted in Finland was ca. 59,670 tonnes a year.

Detailed calculations on the quantity of biowaste, including the analysis of the survey results, are elaborated in the following sections.

The respondents using a home composter for their sorted biowaste (Table 2) were then led to respond to more detailed questions on home composting. They were asked about the quantity of biowaste (kilograms per household a week) taken to a composter at the time the composter was in operation (Table 6) and the operational time of the composter a year (months per year, Table 7). The question regarding the quantity of biowaste was supported by giving instructional conversion factors from volumes to weight of biowaste.

Table 6. Responses to a question: "How much biowaste is taken to a home composter in your household in a week (not including gardening waste)? (1L of biowaste weighs ca. 0.2kg and a bucket-full of biowaste ca. 2kg)" (N = 221).

	No. of respondents	Lowest value (kg)	Highest value (kg)	Average (kg)
How much biowaste is taken to a home composter at your household a week (not including gardening waste)?	221	0.1	10	1.808

Table 7. Responses to a question: "How many months a year do you use a home composter in your household (not including gardening waste)?" (N = 241).

	No. of respondents	Lowest value (months)	Highest value (months)	Average (months)
How many months a year do you use a home composter in your household (not including gardening waste)?	241	1	12	10.8

To ease the evaluation of the amount of biowaste generated, the waste quantity for the whole household was asked instead of asking the waste quantity produced by the individual respondent. The size of a household (Table 8) was considered for all the individual responses to estimate the average quantity of biowaste home composted per person a week.

Table 8. Responses to a question: "How many people live in your household?" (N = 968).

	No. of respondents	Lowest value	Highest value	Average
No. of adults	968	0	6	1.84
No. of youth under 18	968	0	9	0.41
Total no. of people	968	1	12	2.25

The total quantity of biowaste taken to a home composter per person a week when the composter was operational was calculated by dividing the total quantity of biowaste taken to a home composter (Table 6) by the size of household (Table 8). The operational time of the composter a year was also considered when estimating the quantity of biowaste home composted per person a year (Table 7). The estimate on the total quantity of biowaste home composted annually in Finland was estimated by considering the prevalence of home composting amongst population living in different house types (Table 9).

Table 9. The total quantity of home composted biowaste annually in Finland.

House type	Population home composting biowaste	The quantity of biowaste home composted (kg/person a week)	Operation time of the composter (% of a year)	The quantity of biowaste home composted per person (kg/year)	The total quantity of biowaste home composted in Finland (tonnes/year)
Detached and semi-detached houses	1,436,487	0.853	90	39.9	57,372
Terraced houses	32,957				1,316
Blocks of flats	24,570				981
Sum	**1,494,013**				**59,670**

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4. Discussion and Conclusions

The total quantity of home composted biowaste is estimated to be annually approximately 40 kg per person home composting. According to estimates by Natural Resources Centre Finland, the annual amount of food waste produced per person in Finland varied between 53 and 63 kg in 2019 (Silvennoinen;Nisonen;& Katajajuuri, 2022). All kitchen biowaste produced is most likely not sorted to separate collection, but some of it ends up in the sewage, feed for domestic animals, or to residual waste collection. In addition to food waste, kitchen biowaste includes other materials, such as tissue paper, but their share of the total mass of biowaste is rather small (Suomen Kiertovoima ry, 2023). Hence the estimate on home composted biowaste (40 kg per person year) is in line with the estimate on food waste quantities in Finland.

Altogether, approximately 59,670 tonnes of biowaste are annually home composted in Finland. This amounts less than 2% of the total quantity of municipal solid waste in 2021. The estimate is in line with previous national estimates on the quantity of home composted biowaste (Merilehto;Rytkönen;& Tyni, 2004).

It is, however, challenging to estimate the quantities of home composted biowaste, since there is no direct monitoring of the home composted waste quantities in the official waste registries. This type of waste management takes place at the source and the waste is not collected or treated in the centralised, professional waste management system. It is challenging for the people composting their biowaste at home to estimate actual quantities of waste produced, and the waste is generally not weighed for any reason. In addition, the weight per volume of biowaste fluctuates based on the consistency of waste and the total volume changes as the aerobic degradation process proceeds in the composter.

There are always uncertainties related to surveys, such as the intention-behaviour gap, ambiguity in the interpretation of the results or alternative responses, and in this case particularly, the challenge of estimating waste quantities without primary weighing data. People may perceive substantial waste amounts as a negative phenomenon, and thus make underestimations on the total quantity of waste produced.

According to the survey results, home composting of biowaste is rare amongst people living in blocks of flats or terraced houses. Due to the low number of responses from people living in these house types, the differences in home composting practices, such as the effectiveness of sorting or the waste production quantities, are not compared. The shares of population home composting biowaste in the different house types are, however, considered in the estimation, since results from previous studies support the findings (Teittinen, 2017). On the contrary, the differences in the amounts of waste home composted in different house types was not analysed further.

Biowaste collection and treatment has changed in the recent years as a consequence of the expansion of separate collection requirements for biowaste. This has affected the prevalence of home composting particularly in premises with multiple apartments, such as terraced houses. However, there are regional differences in the degree of change in the recent years. The population statistics used in the estimation cover the year 2021. However, the survey was carried out during the first quarter of 2023. Thus, the estimate on biowaste home composting best describes the home composting activity in 2022–2023, which may somewhat differ from 2021. The new survey, however, provides the most accurate view on the current home composting practices compared to the earlier surveys.

Overall, this estimate on home composted biowaste offers the most up-to-date and currently the most reliable evaluation available for the prevalence of biowaste home composting as well as the total quantity of biowaste home composted in Finland. In the future, municipalities' registries on home composters can be used to evaluate the prevalence of biowaste home composting. In addition, the survey data needs to be regularly updated to meet the needs of waste reporting.

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