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# Sample of Dutch FADN 2014

Design principles and quality of the sample of agricultural and horticultural holdings

L. Ge, R.W. van der Meer, H.B. van der Veen and H.C.J. Vrolijk



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The purpose of the EU Farm Accountancy Data Network (FADN) is to be able to evaluate the income of agricultural holdings and the impacts of the Common Agricultural Policy. The Netherlands is required to yearly send accounting data of a sample of 1,500 farms to the European Commission to contribute to the FADN. This task is carried out by Wageningen Economic Research on behalf of CEI. This report explains the background of the farm sample for the year 2014. All phases from the determination of the selection plan, the recruitment of farms to the quality control of the final sample are described in this report.

Het doel van het Europese Bedrijveninformatienet (RICA) is om de inkomens van agrarische bedrijven te evalueren en de impact van het Gemeenschappelijk landbouwbeleid. Nederland dient daarvoor jaarlijks de boekhoudkundige gegevens van een steekproef van 1.500 agrarische bedrijven naar de Europese Commissie te sturen. Deze taak wordt uitgevoerd door Wageningen Economic Research in opdracht van het CEI. Dit rapport geeft een toelichting op de steekproef voor het jaar 2014. Alle fasen van het vaststellen van het selectieplan, de werving van deelnemers tot de kwaliteitscontrole van de uiteindelijke steekproef worden beschreven in dit rapport.

Key words: FADN, sample, population, evaluation, agriculture, financial data

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# Preface

The purpose of the EU Farm Accountancy Data Network (FADN) is to be able to evaluate the income of agricultural holdings and the impacts of the Common Agricultural Policy. The Netherlands is required to yearly send accounting data of a sample of 1,500 farms to the European Commission to contribute to the FADN. This task is carried out by Wageningen Economic Research on behalf of CEI. This report explains the background of the sample for the year 2014. All phases from the determination of the selection plan, the recruitment of farms to the quality control of the final sample are described in this report. This report provides essential background information for the European Commission, the Dutch Ministry, researchers and other organisations to fully understand the statistical aspects of the Dutch FADN sample.



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# Summary

## S.1 Key findings

For the accounting year 2014, 1,515 Dutch farm reports have been delivered to the European Commission. The target number of 1,500 farms has been reached. Farm data are of major importance in the evaluation of agricultural policies and the monitoring of the economic developments in the agricultural sector.

In 2014, 65,508 agricultural and horticultural farms operated in the Netherlands according to the Dutch Structure Survey. The Dutch FADN aims at farms with a Standard Output (SO) of 25,000 euros or more. This field of observation covers 48,509 farms in 2014. These farms are responsible for 99% of total national production capacity measured in SO.

For the accounting year 2014, 73 new farms were recruited. The average response rate among farmers asked to participate in FADN is 16%.

Based on the monitoring of the results of 2014 and before, an improvement of the sample for accounting year 2015 onwards is made for dairy and arable farms. In tree nurseries an improvement has to be made as well. The number of farms per subtype has to correspond better to the numbers according to the census. The monitoring is based on estimates from FADN using the post-stratification weights and the results calculated based on the census.

## S.2 Background

Member states are obliged to have a network for the collection of accountancy data on the incomes and business operation of agricultural holdings. This task is carried out by Wageningen Economic Research for Centre for Economic Information (in Dutch, Centrum voor Economische Informatievoorziening, CEI). The main purpose of the data network is defined as the annual determination of incomes on agricultural holdings and a business analysis of agricultural holdings. For the Netherlands, the European Commission requires the yearly establishment of a selection plan describing the sample of agricultural and horticultural holdings in the Dutch FADN. The selection plan contributes to the harmonisation of the samples from different countries in the EU.

The agricultural census provides the sampling frame for selecting farms to be included in the FADN. Based on the most recent agricultural census, farms are assigned to strata, which are defined by type of farming and economic size class. Only farms with an SO greater than 25,000 euros are included in the sampling frame.

For each stratum the number of farms to be included in the Dutch FADN sample is determined. This number depends on the economic importance of a sector, the number of farms in a stratum, the policy relevance of a group and the heterogeneity of the farms.



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# Samenvatting

## S.1 Belangrijkste uitkomsten

Voor het boekjaar 2014 zijn 1.515 bedrijfsverslagen aan de Europese Commissie geleverd. Het streefgetal van 1.500 bedrijven is dus gehaald. Data van agrarische bedrijven zijn van groot belang bij de evaluatie van landbouwbeleid en het monitoren van de economische ontwikkeling in de agrarische sector.

In 2014 zijn er 65,508 land- en tuinbouwbedrijven actief in Nederland volgens de CBS Landbouwtelling. Het Nederlandse FADN richt zich op bedrijven met een Standaard Output (SO) van 25.000 euro of meer. Deze populatie bestaat uit 48.509 bedrijven in 2014. Deze bedrijven vertegenwoordigen 99% van de nationale productie capaciteit, gemeten in SO.

Voor het boekjaar 2014 zijn 73 nieuwe bedrijven geworven. De gemiddelde respons voor ondernemers die gevraagd werden deel te nemen is 16%.

Gebaseerd op de monitoring van de resultaten van 2014 en daarvoor, is een verbetering doorgevoerd voor boekjaar 2015 in de steekproef voor akkerbouw- en melkveebedrijven. Ook bleek dat het aantal bedrijven per subtype van de boomkwekerij beter in lijn moest worden gebracht met de populatie. De monitoring vindt plaats op basis van een vergelijking tussen de resultaten van de schatting van FADN, gebruik makend van poststratificatie weging, en de resultaten gebaseerd op de populatie.

## S.2 Achtergrond

Lidstaten zijn verplicht om een netwerk voor het verzamelen van de boekhoudkundige gegevens van landbouwbedrijven te hebben. Deze taak wordt in Nederland uitgevoerd door Wageningen Economic Research in opdracht van het Centrum voor Economische Informatievoorziening (CEI). De doelen van het netwerk zijn om jaarlijks de inkomens van landbouwbedrijven vast te stellen en bedrijfsanalyses uit te voeren. De Europese Commissie vereist dat jaarlijks een selectieplan wordt opgesteld. Dit selectieplan draagt bij aan de harmonisatie van informatienetten in verschillende EU-landen.

De Landbouwtelling vormt het uitgangspunt voor het vaststellen van de steekproef voor het Bedrijveninformatienet. Op basis van de meest recente Landbouwtelling worden bedrijven ingedeeld in strata, die zijn gevormd op basis van het bedrijfstype en de economische omvang. Alleen bedrijven groter dan 25.000 euro SO vallen binnen het steekproefkader.

Voor elk stratum wordt vastgesteld hoeveel bedrijven in de steekproef moeten worden opgenomen. Dit aantal is afhankelijk van onder andere de economische betekenis van de sector, het aantal bedrijven in de groep, de beleidsrelevantie en de heterogeniteit van de bedrijven.

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# 1 Introduction

## 1.1 Background

In 1965 the European Commission adopted regulation (nr. 79/65/EEG) in which member states were obliged to set up a network for the collection of accountancy data on the incomes and business operation of agricultural holdings in the European Economic Community. The purpose of the data network is defined as the annual determination of incomes on agricultural holdings and a business analysis of agricultural holdings. The Netherlands was required to provide financial economic information on 1,500 farms to the European Commission.

For the management of the system, the EU requires information on the selection of farms that are included in the national FADN system. In particular the regulation prescribes the provision of data on the establishment of a selection plan and the recruitment of farms. With respect to the selection plan, in article 6 the regulation EEG 1859/82 prescribes:

'Each Member State shall appoint a liaison agency whose duties shall be: ...to draw up and submit to the National Committee for its approval, and thereafter to forward to the Commission: the plan for the selection of returning holdings, which plan shall be drawn up on the basis of the most recent statistical data, presented in accordance with the Community typology of agricultural holdings.'

## 1.2 Objective and structure of the report

The objective of this report is to provide background information on the population, the selection plan, implementation of the selection plan and the quality of the sample of data that are to be provided to the European Commission for the year 2014. The data form the basis for a wide range of national and international research projects.

Chapter 2 gives a description of the background of the Dutch FADN system. Chapter 3 describes the agricultural population. This chapter will also consider the demarcation of the population as used in the Dutch FADN. Also the design of the sample of the Dutch FADN system is described. Chapter 4 gives a detailed account of the selection plan. Chapter 5 provides information on the implementation of the selection plan and the recruitment of new farms. Chapter 6 provides a qualitative and quantitative evaluation of the sample.

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## 2 Statistical background of the Dutch FADN sample

### 2.1 Introduction

In the Dutch FADN detailed records of 1,500 agricultural and horticultural farms are kept. Besides financial information, a broad set of technical, socio-economic, and environmental data are collected. A reason for the Dutch FADN system is the legal obligation to provide information on the financial economic situation of farms to the European Commission. However, an even more important use of the data can be found at the national level. Data from the FADN system are used for many national policy evaluations and research projects.

Based on a sample of farms, estimations are made for the whole population. This might raise the question how conclusions can be drawn for the whole population if only a limited number of farms are observed. The answer to this question can be found in proper sampling techniques such as stratified random sampling (Cochran, 1977). The same is true for the FADN sample. Farms that are included in the FADN should be representative of the whole population. In this way a sample can provide even better information than a census (in which all units are observed). With a fixed budget it is much easier to collect good data on a limited number of farms instead of collecting information on all farms. With a limited number of farms and thus a limited number of data collectors, it is easier to ensure good procedures and good training to collect reliable data.

An important issue is how to ensure that the farms in the FADN sample are representative for the whole population. To this end, the Dutch FADN makes use of a disproportional stratified random sample. A *stratified* sample implies that the population is divided into a number of groups (strata). Subsequently farms are selected from each of the groups. The variables that define these groups should be chosen such that the farms within one group are similar (at least with respect to the important aspects). The FADN sample distinguishes groups based on economic size and type of farming. Sampling farms from each group ensures that the sample includes farms from all groups consequently with different characteristics.

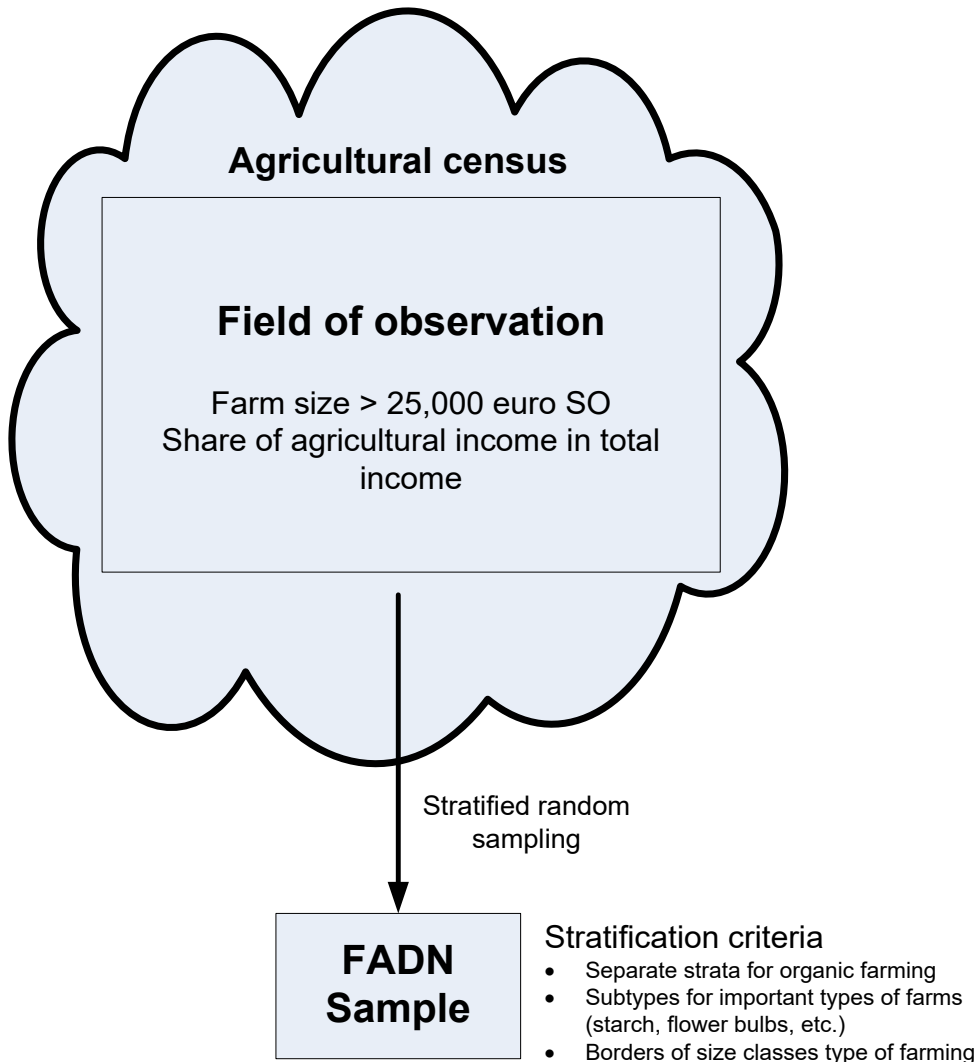
*Disproportional* means that not all farms have the same chance of being included in the sample. Groups which are relatively homogeneous, i.e. having farms that show a high degree of similarity, will have a lower chance of being included in the sample. After all, if all the farms are very similar, a limited number of observations would be sufficient to draw reliable conclusions (in the extreme case that all farms are exactly identical, it would be enough to have only one observation). In case of less homogeneous groups it is important to have a larger number of observations to make reliable estimates. The choice of the stratification variables has therefore an important impact on the quality of the sample.

This way of sampling enables unbiased estimates to be made for the whole population of farms. Stratification assures that all groups are properly represented, thereby allowing separate estimations for all groups. All groups together make up the whole population. In the FADN this is achieved by assigning a weight to each sample farm. The weight is calculated by dividing the number of farms in a group in the population by the number of sample farms in the same group.

Stratification also improves the representativeness of the sample in case of non-response. If a farm which is asked to join the FADN system refuses, another farm in the same size class and of the same type of farming is selected. If there is a difference between the selection plan and the actual implementation, stratification helps to improve the representativeness by taking into account the real sampling fraction.

Finally, stratification makes maintenance of the sample easier. Due to attrition and changes in the population it is sometimes necessary to supplement certain groups. Stratification makes a more focused replacement possible.

The relationship between the agricultural population and the FADN sample is presented in Figure 2.1. The agricultural census provides an almost complete description of the agricultural population. Part of this census or part of this population is defined as the field of observation in the FADN.



**Figure 2.1** Agricultural population and the FADN sample  
Source: Vrolijk et al. (2009).

#### Output measure

For determining the economic size of a farm, the Standard Output is used. Standard Output refers to the standard value of gross production. The Standard Output of an agricultural product (crop or livestock), abbreviated as SO, is the average monetary value of the agricultural output at farmgate price, in euros per hectare or per head of livestock. The sum of all the SO per hectare of crop and per head of livestock in a farm is a measure of its overall economic size, expressed in euros. At the EU level, there is a regional SO coefficient for each product, as the average value over a reference period (5 years). The Netherlands consists of one region.

#### Lower threshold

A lower threshold of 25,000 euros of SO is applied. This threshold has been specified in the legislation underlying the FADN. The historical background was to distinguish small farms which were only held as a hobby or as a side activity from real commercial farms producing for the market. Although the

number of farms excluded from the field of survey is quite substantial, the percentage of production value which is not covered due to this threshold is very limited.

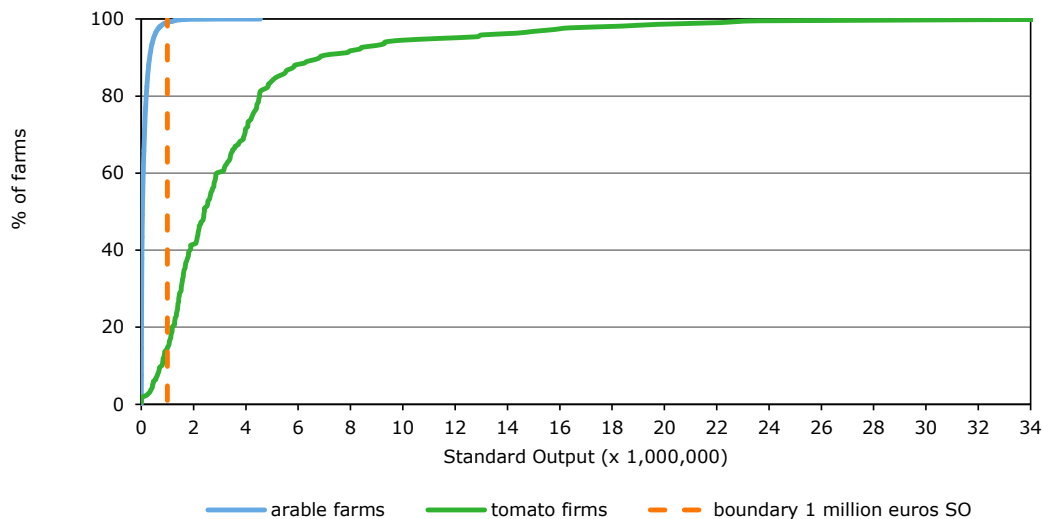
#### *Other income sources*

For practical and methodological reasons a limitation on 'other income of the holding' is used. Clear rules have been specified whether a firm belongs to the field of observation or not. A firm should have at least 25,000 euros of SO from primary agricultural activities, at least 25% of the turnover should come from primary agricultural activities and agricultural activities - in the broadest sense, so as to include other gainful activities - should be the largest share of turnover of the holding.

#### *Stratification criteria*

Given the abovementioned criteria, the field of observation of the FADN system is defined. Within this field of observation a stratification scheme is used. The stratification of the Dutch FADN is based on the economic size of the farm and type of farming. Although these criteria are similar to those used by the Commission, a more detailed look reveals substantial differences with the EU stratification. Differences are for example the use of separate strata for organic farming, and in several types of farming more detailed subtypes of farming are specified which are relevant for Dutch Agriculture (for example starch potato farms, flower bulb farms, horticultural farms by type of production and goat farms).

The Dutch situation is somewhat more complicated compared to many other Member States because the size classes vary across types of farming. The size distribution of, for example, horticultural farms is completely different from the size distribution of arable farms. For 2014 this is illustrated in Figure 2.2. This figure shows that 99% of all arable farms are smaller than 1,000,000 euros of SO, while almost 85% of the tomato firms are larger than 1,000,000 euros of SO (the dashed line marks the 1,000,000 euros of SO level). To take these differences into account, the borders of the size classes have been established for each type of farming separately. Despite this complication the strata are still a cross section between types of farming and size classes. In total 122 strata have been defined.

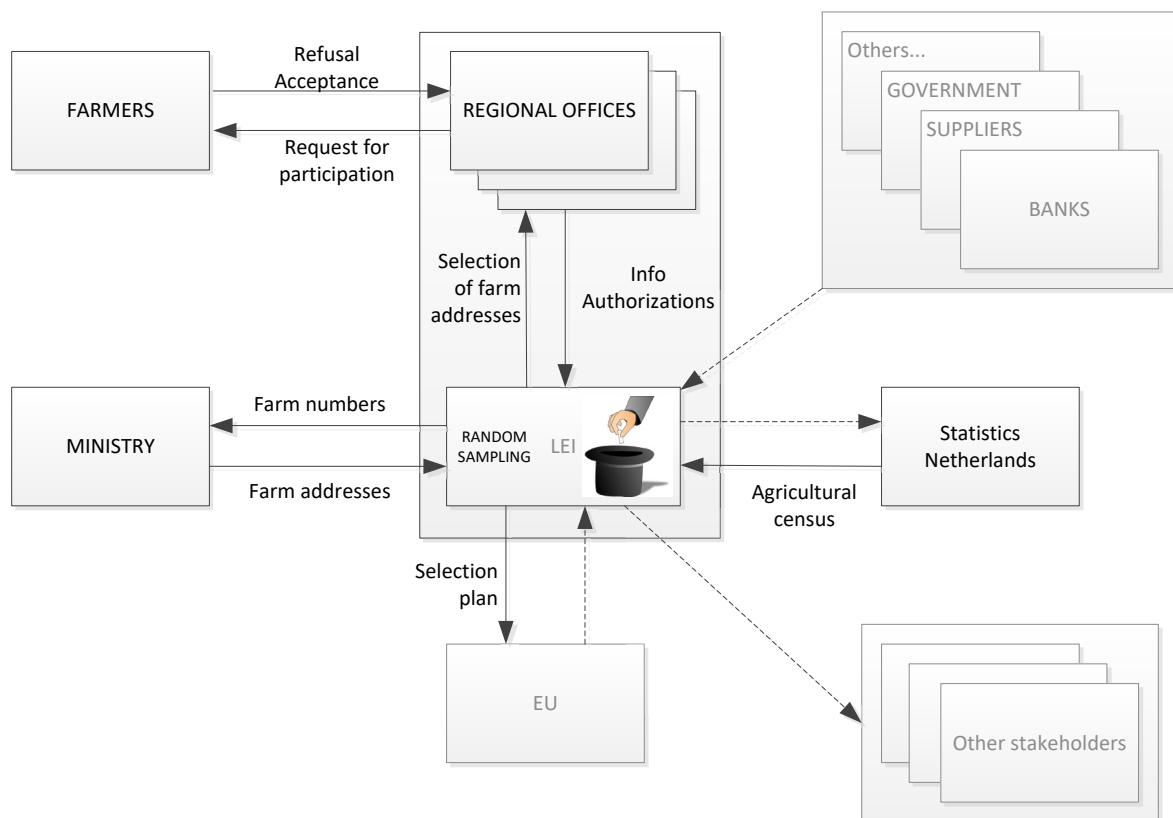


**Figure 2.2** *Distribution of arable farms and tomato firms in 2014*

Source: Agricultural Census, Statistics Netherlands, calculations Wageningen Economic Research.

## 2.2 Sampling and recruitment processes

Figure 2.3 presents an overview of the sampling and recruitment processes. The agricultural census from Statistics Netherlands (CBS) is the starting point for the random sampling of farms. The random sampling takes place based on the selection plan as submitted to the European Commission. The selection plan will be further described in Chapter 4. Based on the selection plan, farms from the agricultural census are randomly drawn. This census (as available to researchers) does not contain addresses but only farm identifiers. The farm addresses from the selected farms are received from the Ministry of Economic Affairs. Farm identifiers are coupled to their addresses and forwarded to the regional offices that are responsible for contacting farmers to request their participation. The farmers may refuse or accept the request to participate and authorisations are collected and forwarded to the central office in The Hague. These authorisations are used to receive electronically available information from banks, suppliers, governmental institutions and others. The information on the acceptance and refusal of farmers is also used to verify the quality of the sample (see Chapter 6).



**Figure 2.3** Sampling and recruitment processes

Source: Vrolijk et al. (2009).

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## 3 Population

### 3.1 Introduction

This chapter describes the population or, more precisely, the field of observation as covered by the FADN sample. Section 3.2 reports the lower threshold and the consequences of its application. Section 3.3 describes the strata which are used to divide the population and reports the number of farms in each of the strata in the population.

### 3.2 Field of observation

Collecting detailed information at farm level requires considerable time and money. To assure an efficient and effective allocation of the available budget, the sample design focuses on certain groups in the population. Given the limited capacity it is important to apply a sampling procedure that optimises the reliability of the sample estimates (through stratification).

In 2014, a lower threshold of 25,000 euros of SO implied that 17,000 farms were not covered by the FADN sample. Although the number of these farms is large, they are only responsible for about 0.92% of the total production capacity expressed in SO. The 2014 population (field of observation) of the Dutch contribution to the EU FADN system is presented in Table 3.1.

**Table 3.1** Number of farms and their relative economic importance (measured in Standard Output - SO) in the 2014 Agricultural Census

	Number of farms	Percentage of farms (%)	Percentage of SO (%)
All farms in the agricultural census (a)	65,508	100.00	100.00
Farms less than 25,000 euros of SO (b)	16,999	25.95	0.92
Total of covered farms (a) - (b)	48,509	74.05	99.08

Source: Agricultural Census, Statistics Netherlands and FADN, calculations by Wageningen Economic Research.

### 3.3 Stratification scheme

Farms are allocated to strata according to two stratification variables: 1) type of farming, 2) size class. As shown in Table 3.2, in total 22 types of farming are distinguished. The number of size classes within a type of farming in 2014 ranges from 4 to 6.

The Dutch FADN farm types differs in its degree of details from the European FADN (FADN, 2012): some farm types are not present in Dutch agriculture (e.g. olives, citrus fruits are not listed) and some types are further detailed (such as vegetables within horticulture). For a number of types of farming a distinction is made between organic farming and non-organic farming. A compromise was found to fulfil the increasing demand for research on organic farms. Random selection of organic farms from the total population would result in a very low number of observations because of the low proportion of organic farms. The definition of separate farm types for organic farms would result in many practical problems. The number of strata would double. The problem of empty or nearly empty strata would increase seriously. In line with the existing stratification, a number of types of farming were selected where organic farming is especially relevant. The types that were originally selected were: dairy farms, field crop farms, field vegetables and combined crop farms (Vrolijk and Lodder, 2002). The growth in the organic sector however was lower than expected and aimed for by policy makers.

This resulted in practical problems in the recruitment of organic farms, for example because the number of farms according to the selection plan was close to or even higher than the actual number of farms in the population. To deal with this problem a number of organic strata have been combined. 'Organic field crops farms', 'field vegetables' and 'combined crop farms' have been integrated in one farm type 'organic crop farms' (Vrolijk, 2006).

The breakdown in subtypes is as follows: 'field crop farms' have been itemised in 'starch potato farms', 'organic crops' and all 'other field crop farms'. The 'vegetables under glass' farms have been broken down in 'sweet pepper', 'cucumber', 'tomato' and 'other'. The dairy farms are split into 'organic dairy farms' and 'non-organic dairy farms'. Within 'field vegetables' and the 'combined crop farms' the organic farms have been separated. These are subsequently combined with the organic field crop farms.

Table 3.2 presents the number of farms in the 2014 population according to size class and type of farming. The table shows that 48,509 farms fall within the field of observation. Dairy farms are clearly the largest group of farms. About one in every three farms is classified as a dairy farm.

**Table 3.2** Stratification of the Dutch FADN sample 2014, including the number of farms per stratum according to the 2014 agricultural census

lower boundary (k€ SO)	25	50	100	250	500	1,000	1,500	3,000	Total
upper boundary (k€ SO)	50	100	250	500	1,000	1,500	3,000	infinity	
<b>Type of farming</b>									
<i>Field crop farms</i>									
- Starch potatoes		269	330	112		27			738
- Organic crops		80	91	61		33			265
- Other field crops		2,999	2,032	1,058		482			6,571
<i>Horticulture</i>									
Vegetables under glass		84	240	206	126	190	144		990
Flowers under glass		64	391	273	143	178	93		1,142
Plants under glass		42	182	130	93	146	155		748
Field vegetables		248	373	111		91			823
Fruit		363	440	399		157			1,359
Tree nursery		654	1,027	245		192			2,118
Flower bulbs		86	253	111		125			575
Other horticulture		393	760	215		237			1,605
<i>Grazing livestock</i>									
<i>Dairy</i>									
- Organic		11	150	134		38			333
- Non-organic		679	4,897	8,439		2,306			16,321
Calf fattening		173	568	364		175			1,280
Other grazing livestock		3,059	1,701	694	268	115			5,837
<i>Intensive livestock</i>									
Pig rearing		27	90	279	319	221			936
Pigs fattening		319	523	343	324	255			1,764
Combined pigs rearing and fattening		13	40	124	261	285			723
Consumption eggs		22	230	219		207			678
Broilers		7	67	112		257			443
Other intensive livestock		26	188	228		170			612
<i>Other</i>									
Combined		772	647	589	476	164			2,648
Total									48,509



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## 4 Selection plan

### 4.1 Introduction

For the Dutch FADN, the allocation of the total capacity of sample farms is based on the relative importance and the heterogeneity of the different types of farming (see Dijk et al., 1995 and Vrolijk and Lodder, 2002). To ensure that the FADN sample adequately reflects the heterogeneity of farms in the field of observation, the field of observation is stratified before the sample of farms is selected.

The EU selection plan guidelines<sup>1</sup> specify the clustering rules, i.e. the aggregations of cells per type of farming when they contain very few or no farms in the field of observation. Following the guidelines, several adjacent economic size classes have been combined. Optimal allocation (distribution of sample capacity over the different strata based on heterogeneity) has been applied (Levy and Lemeshow, 1991).

### 4.2 Selection plan

A summary of the 2014 selection plan is provided in Table 4.1. Given the goals of the FADN system the numbers provided in the table are the required number of observations per type of farming. Compared to the previous year, only the distribution of vegetables under glass over the sub-types has changed. This is related to changes in the distribution in the population.

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<sup>1</sup> [http://ec.europa.eu/agriculture/rica/annex004\\_en.cfm#clustering](http://ec.europa.eu/agriculture/rica/annex004_en.cfm#clustering)

**Table 4.1** Desired sample size per type of farming (selection plan), 2014

Type of farming	Code	Number of farms		
		Main type	Type	Sub type
<i>Field crop farms</i>	1	210		
- Starch potatoes			30	
- Organic crops			30	
- Other field crops			150	
<i>Horticulture</i>		543		
Vegetables under glass	2111		130	
- Sweet pepper				34
- Cucumber				26
- Tomato				36
- Other				34
Flowers under glass	2121		118	
Plants under glass	2122		65	
Field vegetables	2210		50	
Fruit	3610		38	
Tree nursery	2320		60	
Flower bulbs	2221		37	
Other horticulture	2131, 2310, 2331, 3500, 3699		45	
<i>Grazing livestock</i>		433		
Dairy	4500		330	
- Non-organic				300
- Organic				30
Calf fattening	4611		40	
Other grazing livestock	4612, 4810, 4830, 4841, 4842, 4843		63	
<i>Intensive livestock</i>		224		
Pigs rearing	5111		48	
Pigs fattening	5121		48	
Pig rearing and fattening combined	5131		38	
Consumption eggs	5211		30	
Broilers	5221		30	
Other intensive livestock	5231, 5301		30	
<i>Other</i>				
<i>Combined</i>	6, 7, 8	90		
Total		1,500		

# 5 Recruitment of farms

## 5.1 Basic principles

In October 2013, an assessment was made of the farms available for the FADN system for 2014 (considering farms dropping out of the system). The recruitment of new farms for the year 2014 took place from December 2013 to March 2014.

## 5.2 Elaboration of selection plan

Table 5.1 gives a more detailed description of the 2014 selection plan as presented in Table 4.1. Due to changes in the scale of production of the farms, the distribution of the farms over the size classes has changed slightly compared to 2013.

**Table 5.1** Detailed selection plan 2014 per stratum.

Lower boundary (K€ SO)	25	50	100	250	500	750	1,000	1,500	3,000	Total
Upper boundary (K€ SO)	50	100	250	500	750	1,000	1,500	3,000	infinity	
<b>Type of farming</b>										
<i>Field crop farms</i>										
- Starch potatoes		6	13	6			5			30
- Organic crops		5	12	11			2			30
- Other field crops		28	38	54			30			150
<i>Horticulture</i>										
Vegetables under glass		3	32		24		17	24	30	130
Plants under glass		3	7		14		8	14	19	65
Flowers under glass		5	25		33		17	24	14	118
Field vegetables		6	23		10			11		50
Fruits		4	7	15			12			38
Nurseries		5	18		14			23		60
Flower bulbs		3	8		10			16		37
Other horticulture		5	6		20			14		45
<i>Grazing livestock</i>										
<i>Dairy</i>										
- Organic		1	15	10			4			30
- Non-organic		7	93	135			65			300
Calf fattening		3	9		16			12		40
Other grazing livestock	12	12	13	18			8			63
<i>Intensive livestock</i>										
Pig rearing		1	4	13	19			11		48
Pig fattening		1	15	8	11			13		48
Pig rearing and fattening combined		1	6	5	10			16		38
Consumption eggs		3	5		13			9		30
Broilers		1	4		10			15		30
Other intensive livestock		1	9		14			6		30
<i>Other</i>										
Combined		8	13	22	25			22		90
<b>Total</b>										<b>1,500</b>

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## 5.3 Recruitment of farms

Based on the available number of farms in the FADN sample and the expected number of farms ending their participation before or during the period of data collection an estimate was made of the number of farms to be recruited. Furthermore, the variant of accounting has been explicitly considered. Poppe (2004) describes that the introduction of a new accounting system and budget cuts resulted in a large pressure on available capacity. To deal with this pressure, a flexible data collection system has been introduced with two main variants in the data collection: the EU variant and the Corporate Social Performance (CSP) variant. In the EU farm-income variant the most essential financial economic information is collected. This is the information that each member state is obliged to provide to the EU FADN. The information covered in this variant mainly focuses on family farm income, the balance sheet, a limited number of technical data (cropping pattern, livestock) and information on the EU subsidies. In the second variant, the CSP variant, a wide range of data is collected for EU and national purposes. It covers all the topics that are nowadays considered relevant in a report on the sustainability of a company or a farm. Therefore, besides the financial economic information as collected in the EU variant, a wide range of data is collected such as environmental data, other farm incomes, animal welfare, animal health and the level of innovation of firms.

An evaluation has been made of the policy and research relevance of sectors and based on this importance a decision has been made whether a type of farming is assigned to the EU variant, the CSP variant or a combination of both.

Based on the number of farms to be recruited in the CSP variant, the 2014 farms were randomly selected from the 2013 agricultural census. The random draw of farms took place per stratum. The number of farms drawn per stratum was 10 times higher than the required number of farms to ensure enough addresses, even with a high non-response rate in specific types of farming. Using these addresses farms were contacted and asked to participate in the FADN.

For the accounting year 2014, 73 new farms were recruited in the CSP variant. The average response rate is 16%. No enquiry was made of the reason for non-response. As shown in Table 5.2, 73 farms (14% of farms drawn) were considered unsuitable for various reasons. The response rates vary significantly per farm type, ranging from 8% response from the field crops farms to 67% from broiler farms.

**Table 5.2** Response rate in different types of farming, recruitment for CSP variant, 2014

Farming types a)	Number of refusals	Recruited farms	Unsuitable farms	Total farms	Unsuitable %	Response %
<i>Field crop farms</i>						
- Starch potatoes	11	2	7	20	35	15
- Organic crops	13	3	3	19	16	19
- Other field crops	33	7	7	47	15	18
<i>Horticulture</i>						
<i>Vegetables under glass</i>						
- Sweet pepper	14	5	4	23	17	26
- Tomato	27	3	4	34	12	10
Flowers under glass	42	7	10	59	17	14
Plants under glass	16	3	1	20	5	16
Fruit	7	1	1	9	11	13
Tree nursery	37	4	10	51	20	10
Flower bulbs	36	9	3	48	6	20
Field crops	59	5	13	77	17	8
<i>Grazing livestock</i>						
Dairy-organic	0	2	0	2	0	100
Calf fattening	21	7	4	32	13	25
<i>Intensive livestock</i>						
Pigs rearing	10	3	1	14	7	23
Pigs fattening	23	4	1	28	4	15
Pigs rearing and fattening combined	18	4	2	24	8	18
Consumption eggs	2	2	2	6	33	50
Broilers	1	2	0	3	0	67
<i>Other</i>						
Total	370	73	73	516	14	16

a) Only farming types with recruiting activities are displayed

Table 5.3 describes the number of farms where accounts were completed for the first time for the accounting year 2014. Due to several factors this is not exactly the same as the number of newly recruited farms. First, farms can drop out during the first year of participation or even right after recruitment. On second thought farms who were recruited, withdraw their participation. Or the quality of their accounting is too poor to process. Second, this table includes the farms in the EU variant as well. And third, the farm type and size can be different in the year of accounting compared to the year of selection.

**Table 5.3** Number of farms with 2014 as first year of completion of accounting, recruited for EU or CSP variant

Lower boundary (k€ SO)	25	50	100	250	500	1,000	1,500	3,000	Total
Upper boundary (k€ SO)	50	100	250	500	1,000	1,500	3,000	infinity	
<b>Type of farming</b>									
<i>Field crop farms</i>									
- Starch potatoes		0	3	1			0		4
- Organic crops		1	0	2			0		3
- Other field crops		1	5	0			5		11
<i>Horticulture</i>									
Vegetables under glass									
- Tomato		0	0	0	0	1	1		2
- Other vegetables under glass		0	5	0	0	0	0		5
Flowers under glass		1	2	8	1	5	2		19
Plants under glass		0	0	3	0	0	1		4
Field vegetables		0	1	0			1		2
Fruit		0	0	0		1			1
Tree nursery		0	0	1			1		2
Flower bulbs		0	0	4			1		5
<i>Grazing livestock</i>									
Dairy, non-organic		0	4			9			13
Calf fattening		0	0	2		1			3
Other grazing livestock	1	0	0	0		1			2
<i>Intensive livestock</i>									
Pigs rearing		0	0	0	2		0		2
Pigs fattening		0	0	0	1		4		5
Combined pigs rearing and fattening		0	0	0	4		1		5
Consumption eggs		0	0	0			2		2
Broilers		0	0	0			1		1
<i>Other</i>									
Combined		0	0	2	1		2		5
Total									96

a) Only farming types with farms with first year of completion of accounting are displayed.

A comparison of the field of observation (population) and the sample available for research purposes in 2014 is presented in Table 5.4. In 2014 the total number of farms which are available for research providing standard list of variables is 1,519. More detailed data available for research can be drawn from a sample of 1,252 farms (CSP variant).

**Table 5.4** Number of farms in the population and sample according to the EU and CSP variant, 2014

Type of farming	Code	Number of farms		
		Population	Total sample (EU+CSP)	CSP
<i>Field crop farms</i>	<i>1</i>			
- Starch potatoes		738	31	30
- Organic crops		265	30	29
- Other field crops		6,571	155	152
<i>Horticulture</i>	<i>2+3</i>			
Vegetables under glass	2111			
- Sweet pepper		184	25	25
- Cucumber		163	23	23
- Tomato		215	25	25
- Other vegetables under glass		428	38	37
Flowers under glass	2121	1,142	112	109
Plants under glass	2122	748	61	59
Field vegetables	2210	823	45	29
Fruit	3610	1,359	43	37
Tree nursery	2320	2,118	51	27
Bulbs	2221	575	43	38
Other horticulture		1,605	56	24
<i>Grazing livestock</i>	<i>4</i>			
Dairy	4500			
- Organic		333	34	33
- Non-organic		16,321	310	253
Calf fattening	4611	1,280	53	41
Other grazing livestock	4843	5,837	66	48
<i>Intensive livestock</i>	<i>5</i>			
Pigs rearing	5111	936	51	50
Pigs fattening	5121	1,764	49	46
Combined pigs rearing and fattening	5131	723	42	41
Consumption eggs	5211	678	36	33
Broilers	5022	443	30	30
Other intensive livestock	<i>other 5</i>	612	26	0
<i>Other</i>				
<i>Combined</i>	<i>6-8</i>	2,648	84	33
Total		48,509	1,519	1,252

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## 5.4 Supply of farm results to the European Commission

The final delivery of 2014 data to the EU has taken place in December 2015. The target number of 1,500 farms has been reached. Data of 1,515 farms of the accounting year 2014 have been provided to and accepted by the European Commission (Table 5.5). For research purposes 4 additional farms are available (compare Table 5.4); these farms were finalised after the final delivery to the EU.

**Table 5.5** *Number of farms provided to the European Commission*

Accounting year	Provided to the European Commission
2001	1,330
2002	1,358
2003	1,435
2004	1,418
2005	1,458
2006	1,506
2007	1,511
2008	1,501
2009	1,565
2010	1,501
2011	1,478
2012	1,521
2013	1,516
2014	1,515



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# 6 Evaluation of the sample

## 6.1 Introduction

In this chapter the FADN sample for the year 2014 is evaluated both qualitatively and quantitatively. Section 6.2 provides an evaluation of the methodology of stratification and weighting. A crucial element is the calculation of weights. Section 6.3 provides the quantitative evaluation. This section focuses on the quality of the estimations based on the sample. This chapter is based on the standard approach of making estimations based on weights assigned to farms.

## 6.2 Evaluation of stratification and weighting

### 6.2.1 Introduction

This section deals with some practical problems related to the estimation process. Weights of individual farms are used to make estimations of frequencies, totals and averages of groups of farms (aggregated results) based on the data from the agricultural census and the FADN data.

The method to calculate the weights of individual farms is crucial. The goal is to achieve unbiased estimates with a minimal variance. This enables the estimation of the confidence interval of the real population value and the minimisation of the total error. This is true for direct estimators. In the case of a ratio estimator this is not necessarily true, but ratio estimators are outside the scope of this publication (see Vrolijk et al., 2002, for a more extensive description of ratio estimators and other estimators).

### 6.2.2 Method of calculation of weights

The objective of the Dutch FADN system is to give a representative view of the total population. The question is therefore how to draw conclusions on totals, averages and frequencies that are valid for the whole population based on individual farm data. For example, how much is the average family farm income of all farms in agriculture and horticulture? The practical solution is found in weighting: the individual farm data are raised to the population level (for some variables the estimated values can be compared to the data that are available for the whole population, i.e. data which are included in the yearly agricultural census). A weight is assigned to every observed farm in the FADN system. The weight is defined as the ratio between the number of farms in a stratum according to the agricultural census and the number of farms in the sample (in the FADN system). The population in a specific stratum is continuously changing. Therefore the sample and population farms that belong to a stratum in year 2014 are not exactly the same as the farms that belong to that stratum in year 2013. The stratification and post stratification of the farms in 2014 is based on the 2014 agricultural census. Due to these changes, farms included in one stratum could have had different inclusion probabilities at the time of recruitment. In theory, to achieve unbiased estimators these differences in inclusion probabilities should be taken into account in the estimation process. However, the consequence of this would be a very complicated system with many different substrata with different inclusion probabilities. Therefore this complicated procedure is not applied. As a result, the theoretical assumption of a strictly random sample cannot be validated.

Although the calculation method applied in practice can lead to systematic distortions between estimated values and true values, the assumption of a random sample is made. This leads to several practical advantages. The method to calculate weights is relatively easy, involving a limited set of homogeneous strata and resulting in a more effective use of data. A detailed discussion on the

calculation of different weights and the resulted population estimates can be found in Appendix 1 of the 2012 report (Van der Veen et al., 2014).

Because of the applied sampling procedure (see Section 2.1) the different strata have different sampling fractions. Strata with relatively homogeneous units have a lower sampling fraction than very heterogeneous strata. This also implies that farms have very diverging weights. Farms from a homogeneous cluster will have a larger weight (in principle the reciprocal of the sampling fraction) and therefore represent a larger number of farms. The differences in sampling fractions are shown in Table 6.1. These percentages are calculated by dividing the required number of farms in the selection plan (Table 5.1) by the number of population units (Table 3.2).

**Table 6.1** Sampling fractions in different strata (2014 sample)

Lower boundary (K€ SO)	25	50	100	250	500	750	1,000	1,500	3,000
Upper boundary (K€ SO)	50	100	250	500	750	1,000	1,500	3,000	infinity
<b>Type of farming</b>									
<i>Field crop farms</i>									
- Starch potatoes		0.02	0.04	0.05					0.19
- Organic crops		0.06	0.13	0.18					0.06
- Other field crops		0.01	0.02	0.05					0.05
<i>Horticulture</i>									
Vegetables under glass		0.04	0.13		0.12	0.00	0.09	0.17	
Plants under glass		0.05	0.02		0.05	0.00	0.04	0.15	
Flowers under glass		0.12	0.14		0.25	0.00	0.12	0.15	
Field vegetables		0.02	0.06		0.09			0.12	
Fruits		0.01	0.02	0.04				0.08	
Tree nurseries		0.01	0.02		0.06			0.12	
Flower bulbs		0.03	0.03		0.09			0.13	
Other horticulture		0.01	0.01		0.08			0.07	
<i>Grazing livestock</i>									
<i>Dairy</i>									
- Organic		0.09	0.10	0.07				0.11	
- Non-organic		0.01	0.01	0.02				0.03	
Calf fattening		0.02	0.02		0.04			0.07	
Other grazing livestock	0.004	0.01	0.02	0.07				0.07	
<i>Intensive livestock</i>									
Pigs rearing		0.04	0.04	0.05	0.05			0.06	
Pigs fattening		0.00	0.02	0.02	0.03			0.07	
Pigs rearing and fattening combined		0.08	0.15	0.04	0.04			0.06	
Consumption eggs		0.14	0.02		0.05			0.06	
Broilers		0.14	0.06		0.09			0.06	
Other intensive livestock		0.04	0.05		0.04			0.06	
<i>Other</i>									
Combined		0.01	0.02	0.04	0.05			0.13	

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### 6.2.3 Remarks on the weights

In the calculation of aggregate results (averages, frequencies and totals) for the year 2014, the 2014 agricultural census is the starting point. Because of the registration of farms in the population (almost all farms are registered in the agricultural census) the aggregate numbers of farms are exactly the same as the numbers of farms in the census. However, in using these numbers in the calculation of weights for estimations for 2014 two remarks should be made.

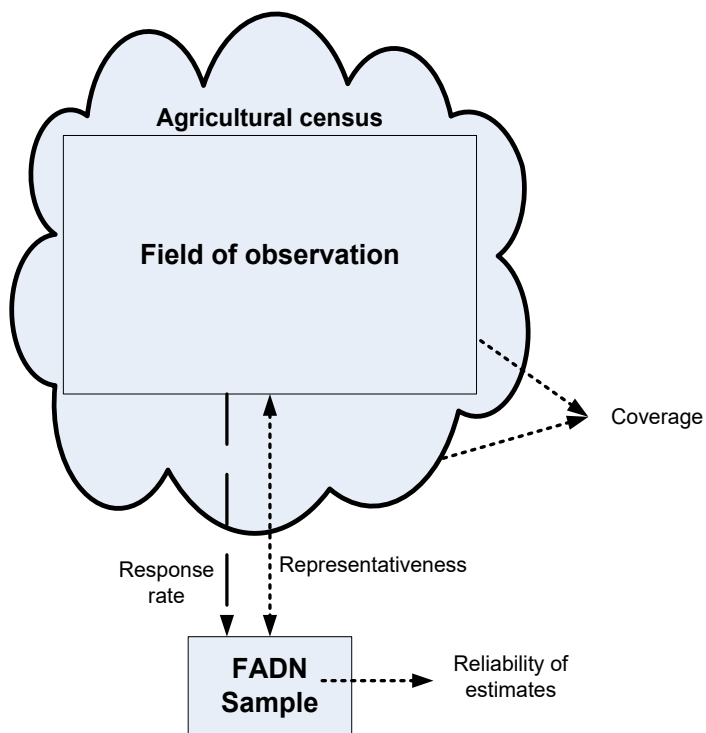
Every year all horticultural and agricultural farms are registered in the agricultural census, but this registration only represents the situation at a certain moment during the year. Therefore it is possible that farms are missing from this registration, although the statistical office tries to correct for that. Furthermore, the number of farms tends to decrease significantly (this trend is stronger for certain types of farms and less strong for others). As a consequence estimations might be overestimations of reality. Distortions in the number of farms in the census can therefore cause incorrect estimations of aggregates.

The typology of farms according to the agricultural census might differ from the typology according to the FADN data. The census reflects the situation at a certain point in time, while the FADN system describes the farm during a whole year. In order to take these differences into account two weighting methodologies are available in the Dutch FADN system. From a theoretical point of view weighting based on the characteristics of the farm in the census is more appropriate. The census is used as the sampling frame; the weights should reflect information from this sampling process. If there are substantial differences, then the variables type and size of farming in the agricultural census are different from the variables size and type of farming in the FADN. In a weighting procedure based on the population numbers in the census and the characteristics in the FADN these variables are considered to be the same.

## 6.3 Quantitative evaluation of the 2014 sample

### 6.3.1 Introduction

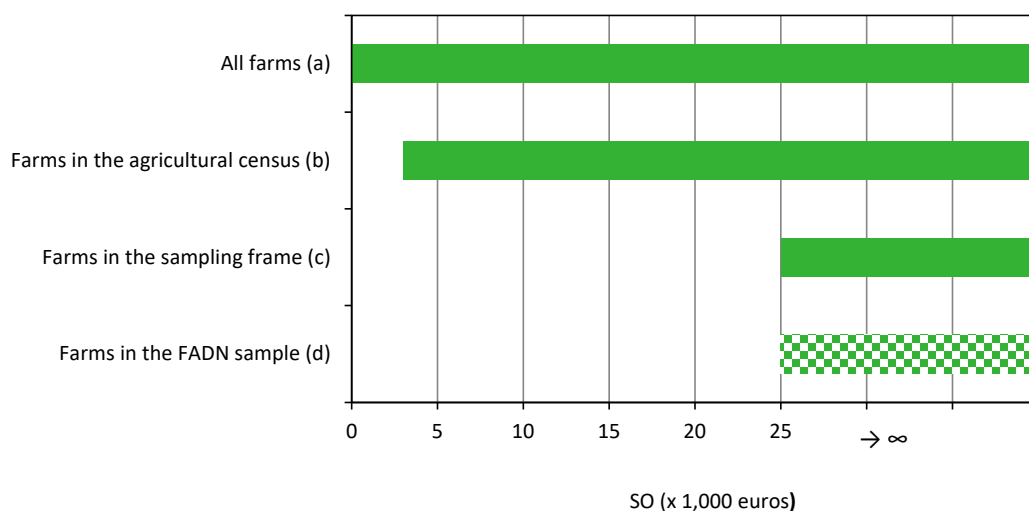
This section focuses on the quality of the estimations based on the 2014 FADN sample. Figure 6.1 shows the same structure as displayed in Figure 2.1, but it adds the quality aspects: coverage, response rate, representativeness and reliability of estimates. The response rate and the accompanying non-response, has already been described in the previous chapter. Section 6.3.2 provides information on the coverage of the sample; the coverage compares the total population as described by the census and the field of observation of the FADN sample. Section 6.3.3 analyses the extent to which distortions might occur between the sample and the population due to over or under representation of farms with specific characteristics; it compares the characteristics of the field of observation and the actual FADN sample. Section 6.3.3 provides information on the reliability of estimates based on the FADN sample.



**Figure 6.1** Quality aspects of the Dutch FADN  
 Source: Vrolijk et al. (2009).

### 6.3.2 Coverage

It is desirable to have a sample that represents the population as accurate as possible. A clear distinction should be made between the coverage and the representativeness. This section describes the coverage, Section 6.3.3 deals with the representativeness. To get an idea about the extent to which the total population is covered by the sample it is relevant to distinguish several aspects (Figure 6.2). Farms that are too small or are not registered in time are not part of the agricultural census (b). The sampling frame (c) is the basis for the choice of sample farms and consists of farms registered in the agricultural census that fulfil the size criteria: larger than 25,000 euros of SO. From this sampling frame the sample is drawn (d).



**Figure 6.2** Relationship between all farms and FADN sample concerning lower threshold

Figure 6.2 gives an indication to what extent the FADN sample in 2014 covers the whole population. Table 6.2 presents some characteristics for the total sample for example: area of crops, number of animals and labour. A comparison is made between the farms in the sampling frame (all the farms that have a chance of being included in the FADN sample) (c) and the total population as described by the agricultural census (b). Direct comparison with all farms (a) would be better but the unregistered farms are unknown, and the practical difference is very limited. The sampling frame covers the population to a large extent. For example with respect to size (calculated in euros of SO), the coverage is 99% (Table 3.1).

**Table 6.2** Coverage of the sample compared to agricultural census, 2014

Selected characteristics of the sample a)	Number according to census	Covered by sampling frame $\geq$ 25,000 SO (%)
Farms	65.507	74,1
Standard output (million euro)	21.220	99,1
Total labour (AWU)	157.872	91,1
Family labour (AWU)	91.312	87,1
Paid labour (AWU)	66.559	96,6
Area (hectare)		
Agricultural area	1.839.061	94,8
Grassland	757.792	92,7
Green maize	225.644	91,4
Arable	986.140	95,9
Winter wheat	122.290	97,0
Sugarbeet	75.094	98,3
Starch potatoe	42.310	99,3
Seed potatoe	39.874	99,9
Ware potatoe	74.068	99,1
Seed onion	22.347	99,7
Horticulture in the open air	85.640	99,6
Headed cabbage	2.727	99,4
Leek	2.593	99,8
Brussels sprouts	2.730	100,0
Asparagus	3.316	99,2
Cauliflower	2.103	99,5
Apple	7.849	99,6
Pear	8.603	99,5
Park trees	6.264	99,4
Hedges	2.506	99,4
Tulip bulbs	11.440	99,9
Horticulture under glass	9.489	100,0
Cucumber	598	100,0
Sweet pepper	1.163	100,0
Tomatoes	1.780	100,0
Chrysanthemum	475	100,0
Roses	311	100,0
Pot plant flower	882	100,0
Pot plant green	410	100,0
Number		
Dairy cows	1.572.287	99,9
Fattening calves	921.276	100,0
Breeding pigs	1.199.075	100,0
Fattening pigs	5.657.191	100,0
Broilers	47.019.796	100,0
Laying hens	46.570.093	100,0

a) Main crops and livestock are listed and not farming types

Source: Agricultural Census, Statistics Netherlands, processed by Wageningen Economic Research.

In policy analysis and research it is essential to distinguish between farming types (for example specialised pig fattening farms) and agricultural activities (pig fattening). In the report on the redesign of the FADN sample it was illustrated that types of farming should not be the only focus of research (Vrolijk and Lodder, 2002). Agricultural activities are important in many research projects.

To give a complete picture of a certain agricultural activity it is important to look at the activities on all farm types. For example, not only pig fattening farms will create added value from pig fattening, also other types of farms can be involved in this activity (although it is not their main business). Table 6.3 describes to which extent a certain activity can be found on certain types of farming in 2014. For example, 81% of the cattle activities can be found on the dairy farms and 14.4% on the farms that belong to 'other farms' category and 3.6% on combined farms. The intensive livestock sector pigs and poultry are highly specialised. Over 90% of the activities can be found on the specialised farms. The activity 'field vegetables' is more diverse. On the specialised farms 65% of the field vegetables (in SO) can be found. The combined and other farms also have a large share of the production of field vegetables.

**Table 6.3** Relationship between types of farming and agricultural activities - share of SO 2014

Animals or crops	Cattle	Pigs	Poultry	Arable crops	Field vegetables	Fruit	Tree Nursery	Flower bulbs	Vegetables under glass	Ornamental plants
Type of farming										
Dairy	81,0	1,1	0,1	17,6	0,7	0,5	0,5	0,9	0,0	0,0
Pig	0,4	90,4	0,3	2,8	2,5	0,4	0,8	1,0	0,0	0,0
Poultry	0,3	0,4	92,0	1,6	0,7	0,5	0,2	0,1	0,0	0,0
Arable	0,1	0,1	0,1	60,1	2,5	0,8	0,2	1,5	0,0	0,0
Field vegetables	0,1	0,0	0,0	0,8	65,0	1,6	0,2	0,2	0,8	0,0
Fruit	0,0	0,0	0,0	0,2	0,2	84,7	0,1	0,0	0,0	0,0
Tree nursery	0,0	0,1	0,0	0,4	0,6	0,5	89,1	0,4	0,0	0,1
Flower bulbs	0,0	0,0	0,0	0,7	0,3	0,2	0,0	67,5	0,0	0,0
Vegetables under glass	0,0	0,0	0,0	0,1	1,5	0,2	0,1	0,0	86,6	0,0
Ornamental plants a)	0,0	0,0	0,0	0,0	0,0	0,3	0,3	5,9	0,3	93,1
Combined	3,6	6,8	5,5	10,9	15,2	8,4	5,8	9,1	0,1	0,0
Other	14,4	1,2	1,8	4,8	10,8	1,9	2,8	13,3	12,1	6,6
Total agriculture	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

a) Consists of cut flowers under glass and pot plants

Source: Agricultural Census, Statistics Netherlands, calculations by Wageningen Economic Research.

### 6.3.3 Representativeness

Because of the stratification scheme, the sample will provide a good representation of the population on the main characteristics (stratification variables) at the beginning of a year. During the year farms might drop out of the sample and changes might occur in the population. Despite these changes the representativeness is maintained by applying post-stratification on the resulting sample and the changed population. Representativeness with respect to the stratification variables does not necessarily imply that the sample is representative for all variables. Such full representativeness is impossible unless the sample size approximates the whole population or all variables highly correlate with the stratification variables.

The representativeness can be analysed by comparing the results estimated from FADN using the post-stratification weights and the results calculated based on the census. For example, the average size of a farm measured in SO can be compared or the average acreage of different crops or number of animals.

Table 6.4 shows to what extent the sample is representative for a number of variables in the agricultural census. When the results of both sources are compared, one should keep in mind that the characteristics of a farm might differ between the census and the FADN due to differences in registration. Comparing the census results and FADN estimates can nevertheless provide insights into potential improvement of representativeness.

The variables analysed are the size of different agricultural activities per farm measured in SO or physical units. The averages per farm of these variables calculated from the census are compared with the averages estimated from the FADN using the post-stratification weights. If the absolute difference between the calculated population average and the estimated average is greater than twice the standard error of the estimates, the difference is considered statistically significant and indicated by an asterisk next to the specific variable. When this occurs, i.e., the estimates significantly differ from the population average, it is considered less likely that the difference can be explained by sampling errors alone with regard to these variables. Attention should then be paid to the assessment and control of non-sampling errors such as non-response bias and data-handling errors.

**Table 6.4** Comparison of farms in the agricultural census and farms in the Dutch FADN

Variable	Average size per farm 2014		Significant (5%)
	Census (farms with SO $\geq$ 25,000 Euros)	FADN	
<i>Size (Standard Output)</i>			
Total	433,438	451,661	*
Arable crops	46,651	50,699	*
Grassland	16,037	15,666	
Horticulture open air	50,580	54,490	*
Horticulture under glass	100,952	94,869	*
Dairy	93,300	101,656	*
Veal	14,093	14,372	
Fattening pigs	28,682	29,710	
Rearing pigs	22,814	23,238	
Broilers	12,698	13,240	
Laying hens	13,366	12,460	*
<i>Size (ha)</i>			
Total	35.94	37.67	*
Arable crops	19.50	21.56	*
Cereals	3.79	4.46	*
Tuberous and root crops	4.73	5.13	*
Permanent grassland	13.48	13.16	
Horticulture open air	1.76	2.12	*
Pome and stone fruit	0.35	0.40	*
Tree nursery	0.32	0.31	
Flower bulbs	0.49	0.75	*
Field vegetables	0.48	0.59	*
Horticulture under glass	0.20	0.19	
Vegetables under glass	0.10	0.09	*
Tomatoes	0.04	0.03	*
Cucumber	0.01	0.01	*
Sweet pepper	0.02	0.03	*
Flowers under glass	0.05	0.05	
Roses	0.01	0.00	*
Chrysanthemum	0.01	0.02	*
Plants under glass	0.04	0.04	
<i>Labour (AWU)</i>			
Male	1.77	1.77	
Paid labour	1.33	1.25	

Source: Agricultural Census, Statistics Netherlands and FADN, calculations by Wageningen Economic Research.

Table 6.4 shows some significant differences between the census and FADN. Although the absolute differences are small in most cases, they are nevertheless significant. The cause can be due to the small standard error of the estimates. This suggests the possibility of non-sampling error. Consider the relatively low responses in certain farm types and strata, the possibility and extent of non-response bias should be assessed using recruitment records. Estimates from FADN using the post-stratification weights and the results calculated based on the census can be used for monitoring the quality of the sample. For example, the average size of a farm measured in SO can be compared or the average acreage of different crops or number of animals. Based on the monitoring of the results of 2014 and before, an improvement for accounting year 2015 onwards is made for dairy and arable farms. In tree

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nurseries an improvement has to be made as well. The number of farms per subtype has to correspond better to the numbers according to the census. So comparing the census results and FADN estimates can provide insights into potential improvement of representativeness.

Table 6.4 gives a description for the whole population. In case of research projects on specific types of farming, similar tables could be generated for farms of that particular type of farming.

A comparison between the sample and the population as registered in the agricultural census does not fully answer the question whether estimations of financial, economic and technical characteristics are bias free. Quality of farm management for example is not recorded in the data and thus cannot be statistically tested. Thus it is possible that farms with relatively good or bad management skills and therefore performance are over represented in the sample.

#### 6.3.4 Reliability

The previous subsection provides some indicators whether there are systematic differences between the sample and the population (representativeness of sample). This section focuses on the reliability of the estimates.

The calculation of averages of groups based on sampling units implies that there can be differences between the estimated value and the true population value. These differences may occur due to the random selection of units to be included in the sample. Table 6.5 provides an indication of the level of precision of the estimates for a set of important goal variables in the 2014 sample.

This section provides the reliability of estimates for a number of important goal variables for different types of farming. This calculation is based on the available CSP observations (see Section 5.3). Table 6.5 and Table 6.6 present the standard errors of estimated goal variables as well as their relative standard error (coefficient of variation). The coefficient of variation is defined as the standard error divided by the group average. A higher coefficient of variation implies less reliable estimates, but the value is strongly affected by the absolute value of the average. If the average value approaches zero, the coefficient of variation can become very large. If the average value is negative, the coefficient of variation is negative as well. This is the case with for example savings.

The precision of estimates is determined by the standard error of the estimate of a variable. The standard error is used to calculate the confidence interval. This confidence interval describes the range in which the true population value will be given a certain level of certainty. The 95% confidence interval (with a critical t-value of 1.96) ranges from the calculated average minus 1.96 times the standard error to the calculated average plus 1.96 times the standard error. For example, the standard error 8,113 for starch potatoes farms signals that average farm income on such farms can vary within the confidence interval  $74,600 \pm 1.96 * 8,113$ , i.e. (€58,700 - €90,500).



**Table 6.5** Standard error of estimates and coefficient of variation (in italics) of important goal variables per type of farming (based on CSP variant, 2014)

Type of farming	Goal variable					
	Farm income, €	Total revenues, €	Return, a)	Savings, €	Total income, €	Net farm result, €
<i>Field crop farms</i>						
- Starch potatoes	8,113	65,185	2.8	7,742	9,574	6,367
	<i>0.11</i>	<i>0.16</i>	<i>0.03</i>	<i>0.33</i>	<i>0.10</i>	<i>0.54</i>
- Organic crops	14,061	68,039	4.7	27,881	14,341	12,330
	<i>0.23</i>	<i>0.17</i>	<i>0.05</i>	<i>-3.41</i>	<i>0.21</i>	<i>-1.58</i>
- Other field crops	6,116	16,726	2.8	6,231	6,516	5,573
	<i>0.21</i>	<i>0.05</i>	<i>0.03</i>	<i>-0.34</i>	<i>0.15</i>	<i>-0.15</i>
<i>Horticulture</i>						
<i>Vegetables under glass</i>						
- Sweet pepper	38,701	78,226	1.4	33,265	39,318	28,797
	<i>0.16</i>	<i>0.02</i>	<i>0.01</i>	<i>0.25</i>	<i>0.15</i>	<i>0.12</i>
- Cucumber	31,587	56,821	1.3	41,151	35,491	28,018
	<i>1.04</i>	<i>0.04</i>	<i>0.01</i>	<i>-0.86</i>	<i>0.71</i>	<i>-0.46</i>
- Tomato	193,964	1,062,844	1.6	159,645	195,477	182,139
	<i>0.40</i>	<i>0.22</i>	<i>0.02</i>	<i>0.44</i>	<i>0.40</i>	<i>0.41</i>
- Other	27,840	131,630	2.8	28,588	27,489	26,873
	<i>0.31</i>	<i>0.14</i>	<i>0.03</i>	<i>0.54</i>	<i>0.30</i>	<i>2.18</i>
Flowers under glass	26,272	98,751	2.0	19,520	26,453	24,589
	<i>0.14</i>	<i>0.07</i>	<i>0.02</i>	<i>0.22</i>	<i>0.14</i>	<i>0.25</i>
Plants under glass	34,142	271,425	2.6	32,562	33,889	33,685
	<i>0.15</i>	<i>0.13</i>	<i>0.03</i>	<i>0.27</i>	<i>0.14</i>	<i>0.26</i>
Field vegetables	274	654	0.00	196	271	254
	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.00</i>	<i>0.01</i>
Fruit	20,544	51,505	6.2	20,931	22,290	18,586
	<i>0.48</i>	<i>0.14</i>	<i>0.08</i>	<i>1,505.79</i>	<i>0.44</i>	<i>-0.54</i>
Tree nurseries	17,255	47,735	6.3	9,557	17,130	15,133
	<i>0.28</i>	<i>0.14</i>	<i>0.08</i>	<i>-2.67</i>	<i>0.26</i>	<i>-0.48</i>
Flower bulbs	37,710	175,542	3.5	33,160	37,564	37,912
	<i>0.19</i>	<i>0.13</i>	<i>0.03</i>	<i>0.30</i>	<i>0.19</i>	<i>0.41</i>
Other horticulture	111,645	523,363	4.4	113,776	111,381	112,312
	<i>0.47</i>	<i>0.40</i>	<i>0.04</i>	<i>0.61</i>	<i>0.45</i>	<i>0.91</i>
<i>Grazing livestock</i>						
<i>Dairy</i>						
- Organic	7,546	17,630	2.8	8,165	9,143	8,687
	<i>0.16</i>	<i>0.05</i>	<i>0.03</i>	<i>1.04</i>	<i>0.16</i>	<i>-0.27</i>
- Non-organic	4,226	10,440	0.8	4,719	4,501	3,829
	<i>0.06</i>	<i>0.02</i>	<i>0.01</i>	<i>0.22</i>	<i>0.06</i>	<i>-0.18</i>
Calf fattening	10,580	52,561	3.5	12,123	10,117	10,017
	<i>0.21</i>	<i>0.15</i>	<i>0.04</i>	<i>0.75</i>	<i>0.16</i>	<i>-0.39</i>
Goats	32,189	60,907	3.9	32,204	31,999	32,291
	<i>0.15</i>	<i>0.09</i>	<i>0.04</i>	<i>0.22</i>	<i>0.14</i>	<i>0.30</i>
Other grazing livestock	15,193	32,883	5.7	16,244	14,926	11,384
	<i>-1.04</i>	<i>0.24</i>	<i>0.10</i>	<i>-0.69</i>	<i>1.54</i>	<i>-0.17</i>
<i>Intensive livestock</i>						
Pig rearing	19,243	55,353	1.7	21,459	18,578	19,498
	<i>0.90</i>	<i>0.06</i>	<i>0.02</i>	<i>-0.90</i>	<i>0.64</i>	<i>-0.33</i>
Pig fattening	8,747	27,270	1.4	8,369	9,082	6,697
	<i>-1.35</i>	<i>0.06</i>	<i>0.02</i>	<i>-0.28</i>	<i>0.83</i>	<i>-0.13</i>
Combined pig rearing and fattening	15,369	85,456	1.2	19,774	16,221	13,961
	<i>-0.59</i>	<i>0.07</i>	<i>0.01</i>	<i>-0.35</i>	<i>-1.18</i>	<i>-0.13</i>
Consumption eggs	19,580	63,491	3.7	21,624	19,325	19,209
	<i>0.65</i>	<i>0.09</i>	<i>0.04</i>	<i>-16.96</i>	<i>0.50</i>	<i>-0.37</i>
Broilers	18,640	144,314	1.0	19,980	19,569	19,576
	<i>0.18</i>	<i>0.09</i>	<i>0.01</i>	<i>0.35</i>	<i>0.16</i>	<i>0.51</i>
Other intensive livestock b)	*	*	*	*	*	*
	*	*	*	*	*	*
<i>Other</i>						
Combined	18,217	47,454	3.9	15,819	19,199	14,250
	<i>0.51</i>	<i>0.11</i>	<i>0.05</i>	<i>-7.09</i>	<i>0.37</i>	<i>-0.33</i>

a) Revenues per 100 euros costs, b) number of observations too low.

**Table 6.6** Reliability of estimates (coefficient of variation in italics) of important goal variables per main type of farming, based on CSP variant (2014)

Type of farming	Goal variable					
	Farm income, €	Total revenues, €	Returns a)	Savings, €	Total income, €	Net farm result, €
Field crops	5,378	16,032	2.4	5,536	5,742	4,884
	<i>0.15</i>	<i>0.05</i>	<i>0.03</i>	<i>-0.40</i>	<i>0.12</i>	<i>-0.16</i>
Vegetables under glass	44,738	238,595	1.3	37,966	45,105	41,866
	<i>0.23</i>	<i>0.10</i>	<i>0.01</i>	<i>0.32</i>	<i>0.22</i>	<i>0.31</i>
Flowers under glass	26,272	98,751	2.0	19,520	26,453	24,589
	<i>0.14</i>	<i>0.07</i>	<i>0.02</i>	<i>0.22</i>	<i>0.14</i>	<i>0.25</i>
Pigs	7,652	27,430	0.9	8,395	7,711	7,002
	<i>-2.55</i>	<i>0.04</i>	<i>0.01</i>	<i>-0.25</i>	<i>0.72</i>	<i>-0.10</i>
Poultry	13,946	68,754	2.3	15,277	14,015	13,958
	<i>0.23</i>	<i>0.07</i>	<i>0.02</i>	<i>0.71</i>	<i>0.20</i>	<i>-0.84</i>
Grazing livestock	4,626	10,884	1.4	5,036	4,698	3,794
	<i>0.10</i>	<i>0.03</i>	<i>0.02</i>	<i>0.42</i>	<i>0.08</i>	<i>-0.12</i>
All farms	1,526	6,208	0.3	1,534	1,539	1,434
	<i>0.01</i>	<i>0.01</i>	<i>0.00</i>	<i>0.02</i>	<i>0.01</i>	<i>0.07</i>

a) Revenues per 100 euros costs.

There are clear differences in the reliability of estimates between different types of farming. Following Table 6.5, the estimates for the dairy sector (non-organic) are the most reliable (the lowest coefficient of variation) because of the large number of farms included in the sample, which reflects the importance of the dairy sector in Dutch agriculture. The decision on the number of farms is described in Vrolijk and Lodder (2002).

The previous tables give an indication of the reliability of estimates for certain types of farming. These tables are used to evaluate the allocation of sampling capacity to the different types of farming. Also in research projects the tables give an indication of the reliability of estimates and should therefore be considered before drawing statistical conclusions.

The tables also give an indication of the dispersion (variability) of observations. A large dispersion makes it more difficult to make precise estimates of group characteristics. Dispersion is however also one of the main advantages of the FADN system. The micro economic information at farm level makes it possible to show and analyse differences between farms, for example research about sustainability performance (Dolman et al., 2012) and the impact of Dutch and EU agricultural mineral policies (Goffau et al., 2012). The European Commission has no requirements regarding the reliability. However, it is one of the factors that is taken into account by determining the distribution of farms over the farm-types and size classes.

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