Natural resources and
bioeconomy
studies 35/2018

Agriculture and food sector in Finland 2018

Jyrki Niemi and Minna Väre (eds.)

Luke
NATURAL RESOURCES
INSTITUTE FINLAND

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Natural Resources Institute Finland, Helsinki 2018

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ISBN: 978-952-326-601-8 (Print)
ISBN: 978-952-326-602-5 (Online)
ISSN 2342-7647 (Print)
ISSN 2342-7639 (Online)
URN: http://urn.fi/URN:ISBN:978-952-326-602-5

Authors: Jyrki Niemi and Minna Väre (eds.)
Publisher: Natural Resources Institute Finland (Luke), Helsinki 2018
Year of publication: 2018
Cover photo: Marjo Keskitalo/Luke
Printed at and publication sold by: Juvenes Print, http://luke.juvenesprint.fi

Foreword

Finland celebrated one hundred years of independence, Donald Trump rose to power in the US, and Robert Mugabe's 37-year rule in Zimbabwe came to an end – 2017 will be remembered for this. In the Finnish agriculture and food sector, 2017 will be remembered for exceptionally poor harvesting conditions. In certain parts of the country, the grain harvest was damaged by exceptional periods of rain and cold weather. At 3.4 billion kilos, the total cereal yield was the second smallest in the 2000s.

The annual review of agriculture and the food industry in Finland, prepared, again, by the Natural Resources Institute Finland (Luke), presents a current outlook for the sectors covered and the most recent research data in a single volume. It provides comprehensive information on the operating environment in agriculture and the food sector, the development of the agricultural and food markets, agricultural policy, the structural development and economic situation in agriculture, and the interaction between agriculture and the environment.

The special themes of this review discuss the opportunities generated by digitalisation for the development of the Finnish food chain, and the identification of the competitive edge of Finnish food both in the domestic market and in exports. Other topics include the future growth prospects of the horticultural production, and the interest among businesses and consumers in the cultivation of insects and insect food. The article on eutrophying phosphorus loading analyses the difficult choices that are made in agricultural water protection.

We hope our readers in and outside Finland will find this report useful.

Helsinki, 15 June 2018

Jyrki Niemi and Minna Väre

Keywords: agriculture and food markets, production, consumption, income, profitability, agricultural policy, the environment.

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1. Operating environment of agriculture

1.1 The food sector in the national economy

In Finland, the total annual consumption expenditure on food and beverages is €23.5 billion. Food and non-alcoholic beverages consumed at home account for almost 60% of this at €13.5 billion. The share of food and non-alcoholic drinks consumed at home is 12.0% of the total domestic consumption expenditure, compared to the EU member state average of 12.2%, and the slightly lower average in the old EU member states, 11.6%,

When alcoholic beverages, €3.3 billion, and eating out, €6.7 billion, are also included, food accounts for 20.8% of household consumption expenditure. Of the consumption expenditure, the share of eating out (5.9%) is lower than the average level in the EU member states (6.9%), and the level in the old EU member states (7.2%).

Food and non-alcoholic beverages, current prices; million euro and %-change (change in volume)

	2015	2016	%-change
Total	23,329	23,490	0.7 (1.0)
Food*	12,292	12,241	-0.4 (0.6)
Non-alcoholic beverages*	1,288	1,272	-1.2 (0.9)
Alcoholic beverages*	3,319	3,303	-0.5 (-0.3)
Catering services (eating out)	6,430	6,674	3.8 (2.5)

*Eating at home

Source: Statistics Finland, National Accounts

In addition to domestic consumption, food produce is also exported and used as intermediate products in production. In 2016, the output of the operators in the food sector was around €27 billion at the basic price. When we add to this the effect of the intermediate product acquisition on the output, the value of the output of the operators in the food sector was around €40 billion. This accounts for around 10% of the output of the national economy at the basic price.

Food and non-alcoholic beverages; percentage of total final consumption expenditure of households

	2015	2016
EU28	12.2	12.2
EU15	11.6	11.6
Belgium	13.3	13.4
Italy	14.3	14.2
Greece	17.1	17.2
Norway	12.2	..
Portugal	17.1	16.9
France	13.3	13.4
Sweden	12.4	12.3
Germany	10.6	10.6
Finland	12.4	12.0
Denmark	11.4	11.4
Estonia	20.6	20.3
United Kingdom	8.3	8.1

Source: Eurostat

Agriculture and horticulture

According to national accounts, the agricultural output at the basic price was €4.4 billion in 2016. The value of the output was down 0.5% on the previous year. The value of the output has decreased for three consecutive years, but this time, the fall was considerably smaller than in previous years (6.9% and 6.5%). The volume of production decreased for the fifth consecutive year. Output at the basic price includes the sales revenues of production, production for own use, and subsidies on products from agricultural aid (€0.3 billion).

When we also consider the other subsidies on production (€1.6 billion), the value of output was €5.9 billion. The other subsidies on production fell by 2.5%, compared to the drop of 7.0% in the previous year.

The value of intermediate products used in production was €3.1 billion. The value of the intermediate products used decreased for the second consecutive year, by around 4% in both years. The volume of demand for intermediate products fell by 1.5%, while the figure for the previous year was 2.1%. In terms of value, agricultural products account for the largest share of the demand for intermediate products , followed by feedstuffs produced by the food industry. Major cost items include construction maintenance, wholesale supply of goods, chemical industry products, and use of energy including distribution. Another major cost is the combined cost of various services that support production.

The agricultural value added at the basic price was €1.3 billion in 2016. The value added increased nominally, by €0.1 billion, or 9.8%, after two years of hefty decreases (-23% and -13.8%). The increase in the value added was caused by a decrease in the value of the intermediate products used. The sector's share of the national value added at the basic price was 0.7%. This figure has remained below one percent, with the exception of 2013 (1.0%).

Agriculture is very capital-intensive because of the machinery, buildings and fields needed in production. In 2016, the value of the total investments in agriculture was €1.1 billion, with an increase of 1.8% on the previous year. In volume, the investments increased by 0.3% on the previous year. Its share of the total investments of the national economy was 2.3%. The share of agriculture of the total investments of the national economy is considerably larger than its share of the value added.

Food processing

In 2016, changes in the food industry were small. The value of the output in the food industry was €10.9 billion. The value of output was almost the same as the previous year with a decrease of 0.3% on the previous year. However, the volume of output increased by 1.3% on the previous year. The value of the intermediate products used, €8.3 billion, is also close to the previous year's figure. The value of the intermediate products used decreased by 0.3%. The volume of the intermediate products used increased by 0.6%. In the food industry, the increase in the value added, €2.6 billion, took a nominal fall of 0.2% on the previous year.

In 2016, the share of the food industry of the value added in the national economy was 1.4%, the same as the previous year. The food industry accounted for 8.3% of the value added in the manufacturing industries, which is slightly less than in the previous year (8.4%).

After the metal, chemical and forest industries, the food industry is the fourth largest industry in Finland in terms of output and value added. Like the forest industry, the food industry is raw material intensive. Intermediate products make up almost 80% of the output. Major cost items in intermediate products include domestic agricultural raw materials and semi-finished products of the food industry.

In 2016, investments in the food industry at home were €517 million, up nominally by 7.7% on the previous year. In volume, the investments increased by almost the same, 7.3%. However, the investments were below the 2014 nominal record level of €539 million. Its share of the total investments of the national economy remained the same at 1.1%. The share

of investments in the food industry of the total investments of the national economy is smaller than its share of the value added in the national economy.

Trade in foodstuffs

The trade sees to the final distribution of food and beverages to consumers. Wholesale traders acquire food and beverages from domestic and international suppliers for sale by retailers. In addition to supplying goods to retailers, wholesalers supply goods to restaurants and institutional kitchens and engage in international trade in foodstuffs. Customer loyalty programmes and advertising are examples of other consumer activities within the trade.

No statistical data is published on the food trade in the national accounts; it is considered part of the trade sector. In the national accounts, the trade output is the intermediation margin excluding the value of the goods supplied. Luke estimates the food trade output to be €5.6 billion, of which the wholesale trade accounts for €1.9 billion and the retail trade accounts for €3.8 billion. Its estimate on the value added in the food trade is €3.0 billion, of which the wholesale trade accounts for €1 billion and the retail trade for around €2 billion. The share of the food trade of the value added in the national economy is around 1.6%.

In order to supply food to consumers goods and services as intermediates from other sectors is needed. The estimated value of the intermediates is €2.6 billion. Major cost items in intermediate products include various business support services, transport and warehousing.

Food trade investments were around €579 million, which is 1.4% of the total investments of the national economy.

Food and beverage service activities

Food and beverage service activities comprise production in restaurants and cafés, and public catering services. In 2016, the estimated value of the sector's output was €5.9 billion. The value of the output increased by 4.1%, and the volume by 2.8% on the previous year.

The value of the intermediate products used in the food and beverage service activities was €3.4 billion, which is up 2.9% on the previous year. The volume of the intermediate products used increased by 3.0%. The value added in the food and beverage service activities was €2.5 billion, up nominally by €0.1 billion (5.6%) on the previous year. The nominal increase in the value added was caused by a higher increase in output compared to the intermediate products used. The share of the food and beverage service activities of the value added in the national economy was 1.4%.

In 2016, investments in the food and beverage service activities amounted to €134 million, up nominally by 17.5% on the previous year. The volume of the investments increased by 16.7%. Its share of the total investments of the national economy was 0.3%.

Economy-wide effects of the food sector

Besides agriculture, the food processing and trade sectors and the food and beverage service activities, many other sectors are indirectly involved in food production by producing goods and services for it. Demand for intermediate products in the food sector generates an output in other sectors to the value of around €14 billion, and value added to the value of around €6 billion. In practice, the effects of the food chain extend throughout various industries, including the transportation, trade and energy sectors and water and waste management.

Households use wages and other income generated from food production for purchasing goods and services, thereby spreading the effects of the food sector to sectors producing consumer goods and

services. There have been no studies on the effect of the income from food production on the national economy.

Direct investments in the food sector amount to more than €2 billion a year, which in turn expand the effects to sectors producing investment goods. The effects of the investments in the food sector on the national economy have not been studied. Part of the spending on machines and equipment, in particular, focuses on other countries. Unlike investments in machinery, the effects of construction focus more directly on domestic technical sectors and the manufacture of construction materials.

Foreign trade in foodstuffs

Import and export of food comprises agricultural products and processed foodstuffs. In 2017, the value of food exports (CN 1-24) totalled €1.6 billion. The value of exports increased by €147 million (10.3%) on the previous year. The value of food imports totalled €5.2 billion. The value of imports increased by €270 million (5.5%) on the previous year. The value of food imports is €3.6 billion higher than the value of exports.

The share of food of the total goods exports is 2.7%, and its share of the total goods imports is 8.4%. In 2017, the value of the total goods exports (CN1-99) increased by 14.8% and the value of the total goods exports increased by 12.8%.

Goods other than food are also imported by the food sector, as the sectors use imported goods in their production. For example, plant protection products are imported in agriculture, and all sectors require imported energy. Domestic sectors producing intermediate products for the food sector also import goods and services required in their production. Most of the machinery, equipment and their parts are imported. The import of services has increased in business management, planning and research, as well as in marketing.

Value-added of agriculture[1], food industry and catering services (current prices, at basic price) and investments.

	Value-added			Share in investments					
	Agriculture	Food industry	Catering services	Agriculture	Food industry	Catering services	Agriculture	Food industry	Catering services
	mill. €	mill. €	mill. €	%	%	%	%	%	%
2016	1,287	2,608	2,524	0.7	1.4	1.4	2.3	1.1	0.3
2015	1,172	2,614	2,390	0.6	1.4	1.3	2.5	1.1	0.3
2014	1,359	2,644	2,281	0.8	1.5	1.3	3.1	1.3	0.3
2013	1,766	2,688	2,246	1.0	1.5	1.3	2.7	1.1	0.2
2012	1,596	2,683	2,331	0.9	1.6	1.4	2.6	1.0	0.3
2011	1,509	2,589	2,214	0.9	1.5	1.3	2.7	0.9	0.3
2010	1,511	2,617	2,092	0.9	1.6	1.3	2.7	0.9	0.3
2009	1,379	2,815	2,003	0.9	1.8	1.3	2.9	1.0	0.3
2008	1,231	2,549	2,023	0.7	1.5	1.2	2.6	1.0	0.2
2007	1,277	2,499	1,957	0.9	1.5	1.2	2.8	1.1	0.3
2006	1,084	2,340	1,803	0.7	1.6	1.2	2.8	1.1	0.3

[1]Agriculture inc. subsidies on products (ca. 300 million €) excl. subsidies on production (ca. 1,600 million €).

Source: National accounts 2006–2016e, Statistics Finland.

However, the share of domestic inputs in the food sector production remains rather high at almost 80%, in terms euros. Production involves a great deal of domestic work.

Taxes and subsidies in the food sector

The state contributes to the food chain by collecting taxes and allocating financial support to agriculture. In addition to value added tax, consumers pay excise duties on prices. Enterprises and wage earners in the food sector pay income tax on their income.

The 14% value added tax on food and restaurant services is lower than the standard 24% VAT rate. The 14% VAT on food and restaurant services took effect at the beginning of 2013. The standard VAT rate of 24% is applied to the retail trade as well as served alcohol.

The VAT revenue from food is €1.7 billion and that from the retail sales of alcoholic beverages €0.6 billion. The VAT revenue from restaurant services is just under €1 billion. The VAT revenue from the food sector is just over €3 billion, around 15% of the total VAT revenue.

The tax revenue from alcoholic beverages is €1.3 billion. The tax on alcoholic beverages has been increased several times in recent years. In 2016, the revenue from excise duty on confectionery, ice cream and soft drinks was €151 million. The duty on confectionery and ice cream became applicable in 2011, and it was abolished at the beginning of 2017.

The revenue from VAT on food and excise duty on alcoholic beverages, in particular, is €4.5 billion.

The tax revenue from the food sector exceeds the subsidies to the sector. In national accounts, subsidies to agriculture and horticulture are divided into subsidies on products and other subsidies on production. In 2016, they amounted to €2 billion. Part of the subsidies come from the EU and part from the state budget. Since Finland's EU membership fees from the state budget are around €2 billion, it can be thought that part of the contribution is returned in the form of agricultural support.

The food sector's impact on employment is around 340,000 people

According to national accounts, the number of people employed in agriculture was 75,200 in 2016, representing 3.0% of the employed labour force. This number decreased by 8,900 from the previous year. This trend is affected by the decreasing number of farms and the use of machinery for agricultural work. Of the people employed in agriculture, 54,200 were entrepreneurs and 21,000 were wage earners.

The number of people employed in agriculture is the greatest in the regions of Southern Ostrobothnia, Southwest Finland, Northern Ostrobothnia and Ostrobothnia (the coastal regions of Vaasa). These regions make up 40% of the total labour force involved in agriculture in Finland. Proportionally, the share of agriculture in the employed labour force is the highest in Southern Ostrobothnia (10.9%), Central Ostrobothnia (9.3%), and the coastal regions of Vaasa (7.7%).

In other sectors, the acquisition of intermediate agricultural products generates employment for some 15,000 people. Most of them are employed in the feed industry and maintenance work within construction. In the service industries, the most people are employed in the maintenance and repair of machinery, the wholesale trade, transport and veterinary services.

The food industry employed 37,000 people in 2016, or 1.5% of the employees in all sectors. This number decreased by 600 from the previous year. A quarter of the jobs in the food industry are located

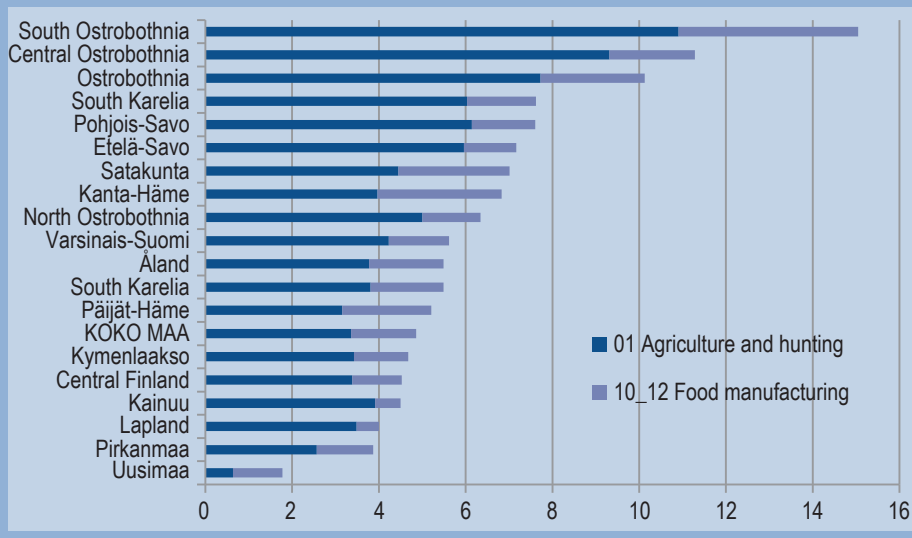
in the region of Uusimaa. 9.5% of the people employed in the food industry are in Southern Ostrobothnia, 7.7% in Southwestern Finland, and 7.6% in Pirkanmaa. Proportionally, the food industry is the largest employer in Southern Ostrobothnia (4.1% of the employed labour force), followed by Kanta-Häme (2.9%) and Satakunta (2.6%).

Indirectly, the food industry offers the most agricultural jobs in raw material acquisition. In addition to agriculture, the food industry indirectly affects most the transport and warehousing sectors, business service sectors, and industries such as packaging.

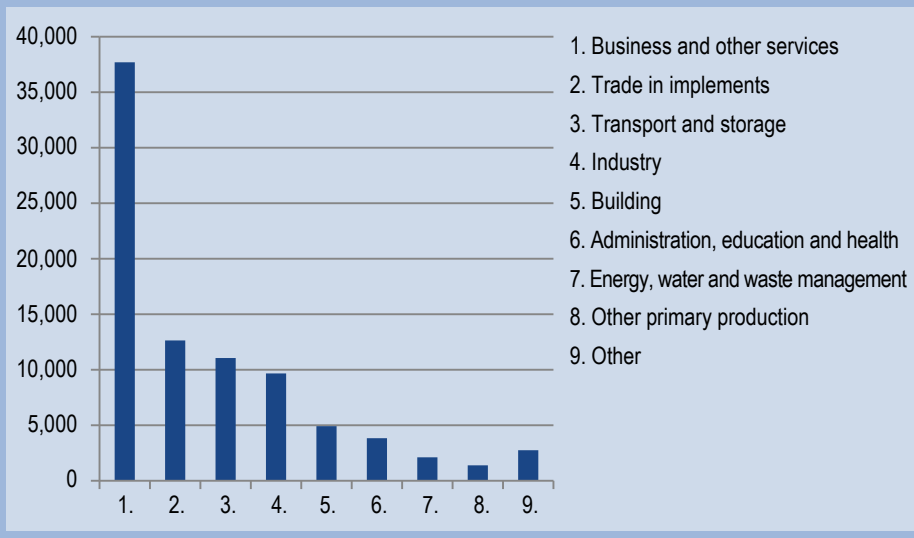
In 2016, the food and beverage service activities employed 70,300 people, representing 2.8% of the total labour force. This number increased by 2,200 from the previous year. Indirectly, the sector provides the most jobs in agriculture and the food industry, but also in various business services, the wholesale trade and transport.

The estimated number of people employed in the food trade is 61,600, of which 11,300 work in the wholesale trade and 50,300 in retail. In addition, the sector employs people indirectly in business services, transport and warehousing. People employed in the food trade, like those employed in the food and beverage service activities, are located where the population is located.

When the employment effect of all sectors is taken into account, the whole food sector employs about 340,000 persons, which is 13 % of the employed labour force. While the jobs in primary production and processing are decreasing, more and more people find employment in restaurants and catering services and in food trade.



Employed of agriculture and food industry (%) in different regions in 2015.
Source: Regional accounting



Employment effects of the use of intermediate products in agriculture by sectors (number of employed persons).

1.2. Food consumption and consumer prices

Food consumption expenditure

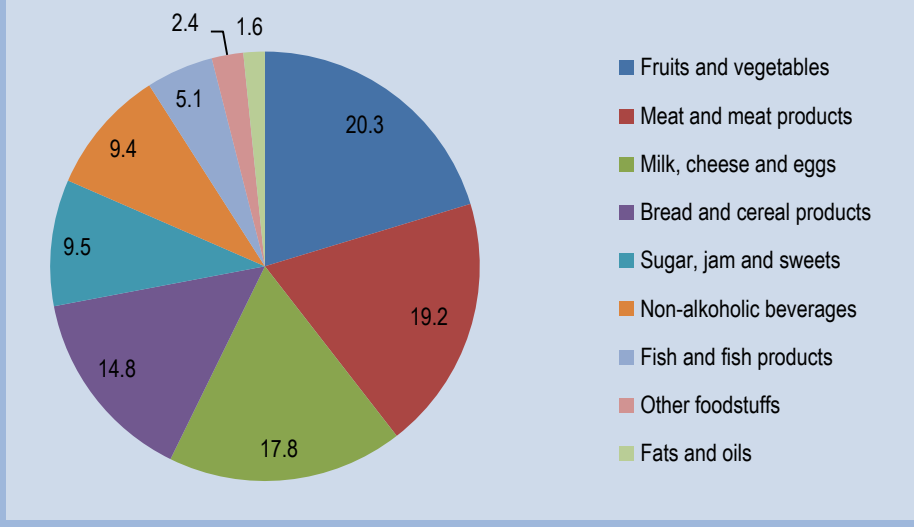
In 2016, consumption expenditure on food and non-alcoholic beverages consumed at home was €13.5 billion. The largest product group is fruit and vegetables with a consumption expenditure of €2.7 billion (20.3%). The value of consumption of fruit and vegetables increased by 2.7%, and volume by 3% from the previous year. Fruit and vegetables are the only main group showing an increase in both value and volume from the previous year. Fruit and vegetables increased their share of the total food expenditure and surpassed the share of meat in 2014.

Meat and meat products account for €2.6 billion (19.2%) of the total food expenditure. The value of meat consumption decreased by 2.5% from the previous year, but the volume increased slightly, by 0.3%. The share of meat of the total food expenditure was at its highest in the early 1990s, at 25%.

The third largest product group in food expenditure are dairy products and eggs, with €2.4 billion (17.8%). The value of consumption in this group fell by 2.7%, but the fall in volume was significantly smaller, 0.9%. Consumption share in this product group was at its lowest in the late 1980s, at 16.2%.

Bread and cereal products are the fourth largest group in consumption expenditure at €2.0 billion (14.8%). The value of consumption in this group decreased, but only slightly, by 0.2%, and the volume increased slightly, by 0.6%. The share of bread and cereal products of the total food expenditure was at its highest in 2004, at 16.9%.

Sugars, jam and confectionery are the fifth largest product group in consumption expenditure with €1.3 billion (9.5%), followed very closely by non-alcoholic beverages at 9.4%. The value of



Final consumption of food and non-alcoholic beverages of households in 2016, %.
Source: Statistics Fi

consumption in both product groups fell slightly from the previous year, by around one percent. The volume of consumption in sugar products fell by similar figures, while the volume in non-alcoholic beverages increased by one percent. These product groups' share of the total food expenditure has remained almost unchanged since 1975. However, in the group of non-alcoholic beverages, the content has changed with the share of coffee, tea, and cocoa down from 70% to 30%, and the share of soft drinks, mineral water and juices has increased.

Fish and fish products' share of the total food expenditure is small, at €0.7 billion (5.1%), and growing slowly. The value of consumption increased by 8.1% from the previous year due to increases in product prices, but the volume fell by 1.1%.

Oils and fats account for €0.2 billion (1.6%) of the total food expenditure. The value of consumption in this group fell by 1.4% and the volume increased by 0.5%. Of all the product groups, oils and fats' share of the total food expenditure has decreased the most. In 1975, oils and fats accounted for 6.6% of the total expenditure.

Consumption in quantity

Most of the consumers' need for energy is still made up of cereal, dairy products and meat. The annual consumption of cereal per person increased by one percent in 2016, to 79.7 kilos. The consumption of wheat, oats and rice grew by approximately 500 grams. The consumption of rye remained about the same, while the consumption of barley fell by approximately 500 grams. The consumption of wheat is the highest in this product group, at 44.7 kilos, but the consumption has been on the decrease in the 2000s. The consumption of rye was 15.5 kilos, and the level seems to have stabilised.

The consumption of other cereals is smaller, and although the consumption has been on the increase, the development is not steady. The consumption of oat, 6.4 kilos, reached the level of 2014. The consumption of barley was 1.8 kilos, compared to 2.4 kilos in the previous year. The

Consumption of some foodstuffs per capita in 2007–2016, kg.

	Fresh vegetables total[1]	Cereals total	Sugar	Meat total[2]	Beef	Pork	Poultry	Eggs
2016	63.7	79.7	29.1	81.0	19.2	34.7	23.5	11.9
2015	62.4	78.8	29.3	79.3	19.2	34.9	21.6	11.5
2014	65.4	80.0	29.5	76.6	18.7	34.6	20.1	10.8
2013	61.2	80.0	28.9	77.1	18.4	35.6	19.5	10.7
2012	57.4	79.2	29.8	77.5	18.9	36.0	18.7	10.6
2011	62.6	78.8	30.1	77.6	18.6	36.4	18.2	10.0
2010	56.1	79.3	31.8	76.4	18.6	34.9	18.2	9.8
2009	59.0	79.5	32.6	74.1	17.8	34.4	17.5	9.5
2008	56.2	80.2	31.8	75.4	18.2	35.3	17.2	9.4
2007	56.4	79.8	30.9	74.9	18.7	34.9	16.4	9.3

[1]Inc. potential waste. [2]Including bones, i.e. carcass meat, incl. edible offals.
Source: Luke, Statistical services.

Consumption of some milk products per capita in 2007–2016, kg.

	Whole milk (litres)	Low-fat milk (litres)	Skimmed milk (litres)	Sour milk	Yoghurt	Sour cream, crème fraîche and smetana	Puddings and quark with additives	Cheese[1]
2016	11.5	65.4	43.4	9.6	20.1	1.9	3.0	26.3
2015	11.7	66.0	48.0	10.1	21.3	2.4	3.2	26.6
2014	12.5	66.4	50.7	10.9	21.2	2.8	2.8	25.0
2013	12.8	66.6	51.2	11.3	22.6	2.7	2.5	23.2
2012	12.5	68.9	50.8	11.8	23.3	2.5	2.2	21.9
2011	11.4	68.3	52.0	11.9	23.9	2.4	2.0	21.0
2010	10.4	68.6	54.5	12.4	23.4	2.3		19.0
2009	10.0	69.9	54.9	12.5	22.5	2.2		18.7
2008	10.2	72.2	53.8	13.0	22.4	2.1		18.4
2007	10.5	74.8	52.3	13.4	22.2	2.0		17.5

[1]Inc. quark, natural and cottage cheese.
Source: Luke, Statistical services.

consumption of rice is 5.8 kilos, showing an increase for the second year in a row. The consumption of other cereals (such as buckwheat and quinoa) is 4.4.kilos, and the consumption is on the increase.

The consumption of meat is 81 kilos per person. The consumption is on the increase for the second consecutive year, following three years of decline. The consumption increased by 1.7 kilos. The increase in consumption was caused by poultry meat (1.9 kg), since the consumption of pork fell by 0.2 kilos, and the consumption of beef remained the same. Consumption of pork meat is the largest in this product group, with 34.7 kg

Food and non-alcoholic beverages yearly price change 2011-2018, %								
	2011	2012	2013	2014	2015	2016	2017	2018
Food and non-alcoholic beverages								
Yearly average	**6.3**	**5.2**	**5.3**	**0.2**	**-1.9**	**-1.1**	**-0.9**	
January	4.6	5.0	5.3	3.9	-1.4	-2.3	-2.4	1.5
February	6.9	4.2	6.1	1.6	-2.4	-1.7	-0.5	1.3
March	6.7	4.4	6.1	0.4	-1.6	-1.6	-1.7	2.5
April	6.1	4.4	6.7	-0.5	-1.6	-0.9	-1.7	
May	7.1	4.8	7.5	-1.5	-1.3	-1.7	-1.0	
June	7.6	4.6	6.3	-0.5	-1.6	-1.6	-1.0	
July	6.9	5.9	6.3	-0.8	-2.7	0.0	-1.5	
August	6.7	5.9	5.0	0.1	-2.4	-0.6	-0.1	
September	6.0	5.8	4.0	0.8	-2.9	-0.7	-0.4	
October	5.6	5.9	3.8	-0.2	-1.3	-1.3	-0.3	
November	6.0	5.3	3.5	-0.4	-1.4	-0.8	-0.3	
December	5.3	5.7	3.6	-1.0	-1.8	-0.6	-0.1	
Consumer price index	**3.4**	**2.8**	**1.5**	**1.0**	**-0.2**	**0.4**	**0.8**	
Source: Statistics Finland, Consumer price index								

per person per year. The consumption of poultry meat exceeded the consumption of beef in 2013.

The consumption of certain foodstuffs per person in 2007–2016, kg.

The consumption of milk dropped by more than 5%, mostly due to the 9.6% decrease in the consumption of skimmed milk. The consumption of other dairy products also fell. The only increase in dairy products was seen in cream, up by just under 5%. The consumption of semi-skimmed mild fell by 0.9% and the consumption of full-fat milk fell by 1.7%. The overall milk consumption per capita averaged 120 litres in 2016. The consumption of buttermilk fell by 5%, while the consumption of curdled milk (viili) remained at the level of recent years. The consumption of yogurt fell by 5.6% from the previous year. The consumption of cheese has been on the increase for several years, but fell now by 0.3 kg to 26.3 kilos.

The annual consumption of butter is 3.4 kilos per person. The consumption was on the increase from 2008 to 2013, but has remained the same for the past two years.

Egg consumption continued to grow. In 2016, the consumption of eggs was 11.9 kilos per person, which is up by 0.4 kg on the previous year.

The consumption of fresh vegetables is 63.7 kg per person, but this figure includes potential waste. The consumption increased by 1.3 kilos. Of fresh vegetables, the share of tomatoes is just over 12 kg, or about 25%.

The consumption of fresh fruit is 60.5 kilos, including potential waste. Of this, citrus fruit have accounted for almost 25%, but their share has been on the decrease as the consumption of other fruit has been increasing.

Sugar consumption is decreasing slowly. In 2016, the consumption was 29.1 kilos per person, down 0.2 kg on the previous year. In the early 2000s, the consumption was nearly 33 kilos.

Food and non-alcoholic beverages yearly price change by product groups 2011-2017, %.							
	2011	2012	2013	2014	2015	2016	2017
Food and non-alcoholic beverages	6.3	5.2	5.3	0.2	-1.9	-1.1	-0.9
Grain products and bread	5.3	3.0	4.1	-0.4	-2.2	-0.9	-0.1
Meat	5.3	7.7	7.0	-1.7	-2.7	-3.4	-1.2
Fish and shellfish	6.3	1.5	10.5	2.2	-1.3	8.0	7.3
Milk products, cheese and eggs	3.6	4.8	5.9	0.3	-4.4	-2.6	-0.6
Fats and oils	8.0	7.5	2.7	-1.5	-6.2	-1.9	1.8
Fruits and berries	3.4	2.1	9.9	-2.3	-0.8	0.0	1.3
Vegetables	1.3	5.3	8.7	-1.5	-0.2	0.3	-2.8
Sugar, jams, honey, chocolate and candies	13.8	8.3	2.7	1.1	-0.1	0.1	-10.5
Prepared food, other	6.1	4.8	2.3	0.0	0.0	-1.4	-1.3
Non-alcoholic beverages	16.3	4.9	-2.8	6.6	1.5	-2.2	2.4
Source: Statistics Finland							

Consumer prices

On average, the consumer prices of food continued to fall in 2017, but the decrease was smaller than in the two previous years. In 2015, the prices fell by 1.9%, in 2016 by 1.1%, and in 2017 by 0.9 %.

This period of falling prices was preceded by a period of rapid rise in 2011–2013, with food prices rising by 20%. The rise continued until March 2014. On the annual level, the prices rose by 5-6%, which is considerably more than the average fall of 1-2% in the next years.

The consumer prices continued to fall until the end of 2017. A significant decrease in the price level occurred in February 2015 and another one in July-September 2015. In January 2016 and 2017, the consumer prices of food were also more than 2% lower on average than the previous year.

In addition to poor economic development, slow growth in demand and decreased prices of raw materials, the lower prices were a result of the import bans imposed by Russia and the cheapening campaigns in the retail trade. At the beginning of 2018, food prices began to rise again, and they are believed to continue to rise for the next two years at least.

In 2011–2013, the consumer prices of cereal products increased annually by 3-5% on average. With this in mind, the decrease in prices in 2014–2017 was moderate, as the average annual decrease was 0.4-2.2%.

In 2011–2013, the consumer prices of meat and meat products increased annually by 5-8% on average. In 2014–2017, the average annual decrease in prices was 1.2–3.4%.

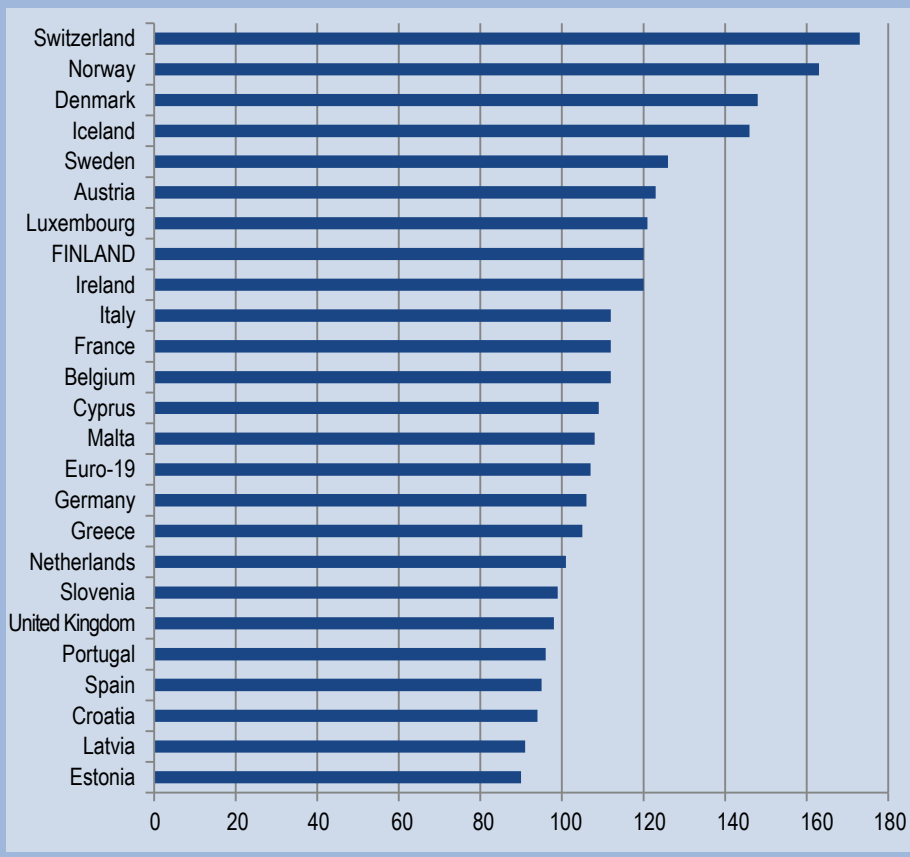
In 2011–2013, the consumer prices of dairy products increased annually by 4-6% on average. The prices continued to increase slightly in 2014, with the consumer prices up 0.3% on the previous year. In 2015, the prices of dairy products fell by 4.4%. This was a result of the import ban imposed by Russia in August 2014.

The consumer prices of fish products increased in 2011–2017, with the exception of 2015. 2013 saw an exceptionally substantial increase, with consumer prices up by an average 10.5% on the previous year. In 2011, 2016 and 2017, the prices also rose by 6-8%. The increase of the price of fish products in recent years is the result of production problems in the large fish-producing countries.

The consumer prices of fats and oils increased considerably in 2011–2012, by 8% a year. In 2013, the prices rose further by an average of 2.7%. Then again, in 2014–2016, the prices fell. The most considerable decrease (6.2%) occurred in 2015. In 2017, the consumer prices rose by 1.8%. The consumer prices of oils and fats are affected by fluctuations in the world market price of butter.

In Finland, fruit is mainly imported. The share of imports in vegetables is also large, although Finnish consumers like to buy domestic products, tomatoes in particular. The consumer prices of both fruit and vegetables increased in 2011–2013. The increase was particularly strong (9-10%) in 2013. The prices of vegetables also rose significantly in 2012, by 5.3%. The prices fell by 2% in 2014, but only be less than 1 % in 2015. In 2016, the consumer prices of fruit remained the same, but the prices of vegetables rose slightly. In 2017, the prices of vegetables fell by 3% and the prices of fruit rose by just over 1%.

In 2011–2013, the consumer prices of food preparations increased annually by 2-6% on average. In 2016–2017, the prices fell, but, at just over 1% annually, the decrease was moderate in comparison with the rate of increase. Food preparations include ready-meals, for example.



Price level index for food and non-alcoholic beverages in some countries in 2016, EU-28=100.
Source: Eurostat

In 2011, the consumer prices of non-alcoholic beverages rose by 13.8%, and the increase continued in the following year (4.9%) and in 2014 (6.6%). The duty on soft drinks was increased at the beginning of 2011, 2012 and 2014. In 2013, the consumer prices fell by 2.8%, while prices in other product groups rose. In 2016, the consumer prices of non-alcoholic beverages were also 2.2% lower than the previous year. The consumer prices of non-alcoholic beverages show fluctuations in the world market prices of coffee, tea, cocoa and juice, but the effect is smaller as the share of soft drinks in this product group has grown.

Value chain of the food basket

We can think that the price of the domestic food basket, €13.5 billion, is divided between agriculture that produces the raw material , the food industry that processes the raw material, and the food trade that sells products to consumers. We can further divide the sum to product taxes and processed food imports, i.e. the food and beverages that are not processed further by the Finnish food industry.

State product taxes account for approximately €1.9 billion, or 14%, of the value of the food basket. According to data from Statistics Finland, the estimated share of processed food imports is around €2 billion, or 15.5%. The estimated share of the food retailing including transport is €4.5 billion, or 33.5%, as is the share of the food industry, €4.5 billion, or 33%. The share of agriculture is made up of the unprocessed products in the food basket, an estimated €0.4 billion, and of the raw material costs included in the share of the food industry, just under €1 billion.

Over the years, the share of the retail sector in the price paid by the consumer has grown while the shares of primary producers and the processing sector have decreased.

Comparison with other countries

Statistics Finland has published an international price comparison of consumer prices. The data is based on the Eurostat Price Comparison Programme, ECP . The objective of the international price comparison is to produce purchasing power parities. 28 EU member states were included in the comparison, as well as certain candidate countries and the EFTA countries. The price data on Finland for this survey was collated by Statistics Finland.

In Finland, the price level of food and non-alcoholic beverages exceeds the EU average by 20%. The same price level can be found in Luxembourg and Ireland. The price level in Norway exceeds the EU average by 63%, in Denmark by 48%, in Iceland by 46% and in Sweden by 26%. Switzerland has the highest price level, with the consumer prices of food and non-alcoholic beverages exceeding the EU average by 73%. Poland and other countries in Eastern Europe have the lowest price levels.

International comparison of prices is complex, however. The consumer prices of food are affected by different tax policies, national characteristics and eating habits, in addition to labour costs, market structures, and production conditions. In Finland, VAT on food is the second highest in the EU-15, at 14%. In the UK and Ireland, VAT on food is 0% and in Denmark, it is 25%.

Studies have also shown that structural features, specifically the competitive situation at the producer and retail levels, have an impact on prices and price dispersion. Although there is some empirical evidence of a reduction in price dispersion over a longer time period in the EU, price differences remain substantial across a range of goods, with evidence of only limited convergence.

Average consumer prices of some foodstuffs in April 2015–2018, €/kg.				
	2015	2016	2017	2018
	February	February	February	February
Wheat flour	0.67	0.66	0.65	0.65
Rye bread, portion size	3.78	3.65	3.54	3.58
Beef roast	16.2	15.53	15.78	16.43
Pork, strip	9.19	8.95	8.78	8.65
Chicken breast fillet	13.19	12.98	12.95	12.36
Light milk, €/litre	1.04	1.02	1.0	0.99
Edam cheese	9.14	8.86	8.58	9.1
Eggs	3.58	3.64	3.23	3.42
Butter	4.96	4.92	4.88	5.98
Margarine	3.7	3.55	3.43	3.58
Tomatoes	4.1	3.95	3.87	3.83
Potatoes	0.88	1.03	0.83	0.88
Source: Statistic Finland, Consumer prices				

Average consumer prices of some foodstuffs in 2013–2017, €/kg.						
	2013	2014	2015	2016	2017	Change % 2016–2017
Wheat flour	0.69	0.68	0.68	0.66	0.65	-1.5
Rye bread, portion size	4.05	3.92	3.74	3.59	3.54	-1.4
Beef roast	16.88	16.74	16.21	16.07	15.99	-0.5
Pork, strip	9.39	9.27	8.99	8.88	8.53	-3.9
Chicken breast fillet	13.75	13.47	13.18	13.02	12.84	-1.4
Light milk, €/litre	1.05	1.1	1.03	1.01	0.99	-2.0
Edam cheese	9.69	9.8	9.12	8.77	8.8	0.3
Eggs	4.25	3.68	3.6	3.45	3.27	-5.2
Butter	6.12	5.74	4.96	4.92	5.16	4.9
Margarine	3.85	3.9	3.6	3.48	3.53	1.4
Tomatoes	3.08	3.25	3.19	3.03	2.92	-3.6
Potatoes	0.94	0.87	0.93	0.97	0.85	-12.4
Source: Statistic Finland, Consumer prices						

1.3 Retail trade

The consolidation trend in the Finnish retail sector has continued for an extended period, resulting in the two largest chains having a market share of around 80% in the 2010s. The S Group in particular has expanded strongly since 2005, increasing its lead over Kesko to more than 13 percentage points by 2015. The difference between the two leading chains levelled slightly with Kesko's acquisition of Suomen Lähikauppa in April 2016. The acquired units had their first full year of operation in 2017. This increased Kesko's market share to 35.8%, to around 10 percentage units from S Group. Lidl grew steadily in 2016 and 2017. In 2017, the German chain expanded its network of supermarkets by 16 new units.

In 2017, the most significant single market event was the sale of Stockmann Delicatessen to the S Group. The transaction was published in summer 2017 and approved by the FCCA in late 2017. Officially, the Stockmann Delicatessen units were transferred to the S Group at the end of 2017/beginning of 2018. In 2016, Stockmann Delicatessen accounted for 1% of the total sales of daily consumer goods and it will increase the market share of the S Group this year, but the impact will be smaller than that of Kesko's latest acquisition.

In 2017, the total sales of daily consumer goods amounted to €17.6 billion, which is up 1% on the previous year. The growth reflects the consumers' increasing purchasing power and the moderate upward turn in the economy as a whole.

The rapid progress of the Lidl chain and the S Group's cheapening campaign prove the significance of price when it comes to steering consumer choices. The economic recession made consumers more price-sensitive. Consumers turned to more affordable foods which, in turn, has led to a rise in the popularity of discount stores and own brands all over Europe.

The own brands of retail chains have, in fact, been given much more shelf space than before. Previously, they played a major role in non-food goods and dry foodstuffs, but own brands have in recent years been introduced in an increasing number of product groups. For example, in dairy products they have achieved a significant position over the past 3–4 years in the sales of liquid milk, fresh products and cheese.

The increasing number of own brands, the threat posed by imported goods, and

Market shares of retail companies in 2006–2017

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
S Group	33.9	39.9	41	42.4	43.2	44.1	45.2	45.6	45.7	45.7	45.9	44.6	45.9
K Group	35.9	33.4	33.9	33.7	34.2	35	35.3	34.7	34	33.1	32.7	34.8	35.8
Suomen lähikauppa*	10.8	11.9	11.9	11.3	10.2	9	7.8	7.3	7	6.8	6.4	1.4	-
Spar**	6.2	0.5	-	-	-	-	-	-	-	-	-	-	-
Lidl***	3.7	4.1	4.7	5	5.1	4.8	4.8	5.5	6.6	7.6	8.3	8.8	9.3
Other companies	9.5	10.2	8.4	7.6	7.3	7.1	6.9	6.9	6.7	6.8	6.7	10.4	9.0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

*Source: AC Nielsen. *Earlier Tradeka. **From 2006 M Group; in 2007–2008 included in "Other". ***Nielsen's estimate*

Obs. In 2016, variety discounters and gas station stores selling a more narrow grocery assortment have retroactively been added to Nielsen's Sales Directory. Due to the retroactive inclusion of new markets in 2016, the figures presented in the table are not comparable with the previous years.

the price level and limited selection of discount stores intensify competition between Finnish suppliers and bring production margins down.

The sale of daily consumer goods continues to concentrate on large units at a fast rate. In addition to Lidl, the most successful chains in 2017 were the hypermarket chains of the S and K groups. The sales of the Citymarket and Prisma chains increased by 4.3–4.5%, which is considerably faster than the growth rate in the sector. Shops with a floor area below 400 m2 continued to lose out, with sales down by 6.6% on the previous year. In 2017, 220 smaller shops shut down, which is the largest figure in 20 years.

In many countries across Europe, online trade has challenged hypermarket chains in non-food product groups. However, online food sales are still marginal in Europe, and in Finland, their share of total sales is 0.3%.

1.4. The food industry and foreign trade

Trends in the food industry

In 2016, food industry turnover was €10.4 billion, which is exactly the same as the previous year. The number of employees in the food industry decreased substantially and reached the level of the early 2010s. The number of employees in 2016 was 32,715, which is down on the previous year by 938 people. This almost 3% drop means that the personnel trend reverted to the long-term trend.

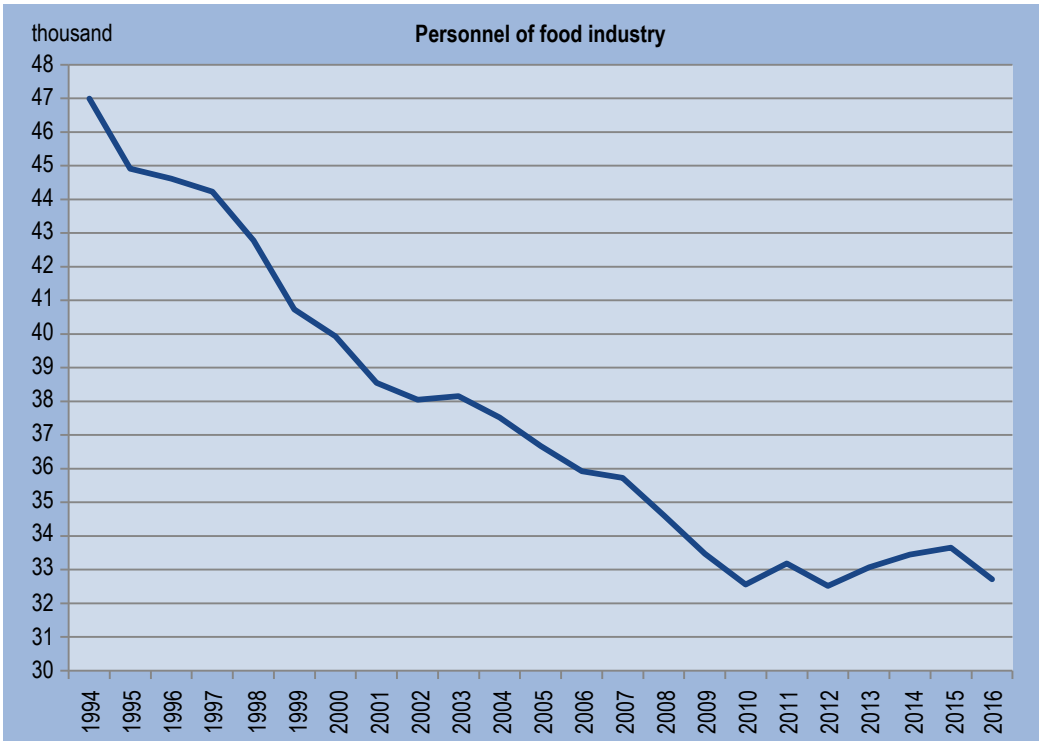
As a result of the decrease in staff numbers and the stable turnover, the real turnover per person in 2016 increased to €318,000 in the food industry. This indicator of productivity has been on a steady increase since Finland joined the EU, but in 2012, it reached its highest point and has been decreasing at a worrying rate since this time. The positive turn in 2016 may indicate the return of a positive trend, especially since we know that, having been hit hard by the Russian import embargo, food exports took an upward turn in 2017 after falling for several years.

The two main sectors in the Finnish food industry are the dairy and meat processing industries. Together, they accounted for 43% of the food industry turnover in 2016. The dairy industry peaked in 2013, when prices on the demand-driven world market were high, and a new sales record was achieved

Turnover of the Finnish food industry (at current and fixed prices) in 1995-2016.

	Turnover (at current prices, billion €)	Turnover (at 2016 prices, billion €)
1995	7.7	10.6
1996	7.8	10.7
1997	8.0	10.9
1998	7.8	10.4
1999	7.5	9.9
2000	7.9	10.1
2001	8.3	10.3
2002	8.4	10.2
2003	8.5	10.3
2004	8.9	10.7
2005	8.9	10.6
2006	9.2	10.9
2007	9.7	11.2
2008	10.5	11.6
2009	10.3	11.3
2010	10.2	11.1
2011	10.8	11.4
2012	11.2	11.5
2013	11.0	11.2
2014	10.8	10.8
2015	10.4	10.5
2016	10.4	10.4

Source: Statistics Finland, Finnish Enterprises 1995-2016.



Source: Statistics Finland, Finnish Enterprises 1995-2016.

in the Russian market. At that time, the turnover of the dairy industry exceeded that of the meat processing industry. The dairy industry subsequently faced difficulties in the market resulting in a steep decline, and order in the two largest industries was restored. The real turnover of the meat industry has remained stable in recent years because entry into new markets and exports to Asia are not shown in the 2016 figures.

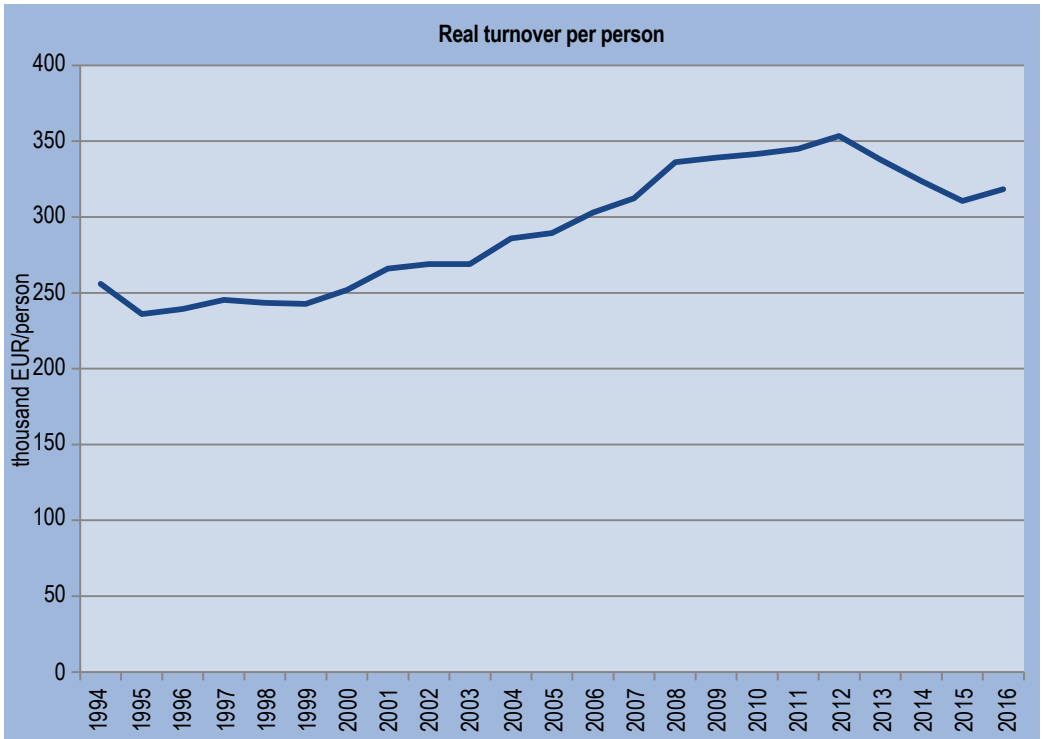
Foreign trade

In 2017, Finland's food exports finally took an upward turn after the crisis caused by the Russian sanctions. After four negative years, exports increased by €147 million. In 2017, food exports from Finland totalled €1,579 million, an increase of 10% on the previous year.

In 2017, the value of food imports to Finland was €5,205 million, which is up just over 5% on the previous year. This means that, after a few moderate years, the growth rate in imports has regained the level of the early 2000s.

The combined outcome of the developments in exports and imports is that the deficit in the food trade grew reasonably, by around €123 million, from €3,504 million to €3,627 million. Traditionally, the balance deficit has mainly been due to the large import volumes of fruit, vegetables, raw coffee, alcoholic beverages and tobacco. Other important products imported to Finland include vegetables, cheeses and cereal products. However, in recent years, the Finnish food industry has been faced with competition in product groups that used to be dominated by domestic production, such as meat, dairy and fish.

There have been no significant changes in the geographical distribution of

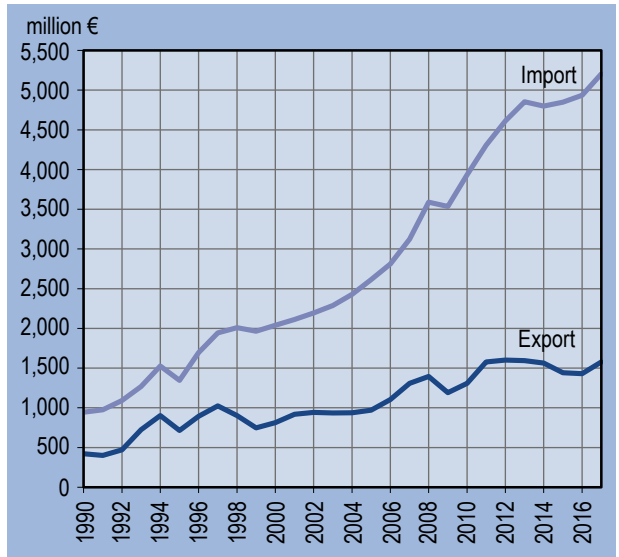


Source: Statistics Finland, Finnish Enterprises 1995-2016.
Note: turnover in 2016 prices.

imported agricultural and food products. In 2017, the majority (65.2%) of Finnish food imports came from the old EU countries. Food imports from countries that joined the EU in 2004 or later increased from the previous year and were at 10.5%. The share of non-EU countries fell to 24.2%.

As a result of the sanctions, exports to Russia have fallen dramatically. In the peak year of 2013, the value of food exports to Russia was €442 million. In 2015, exports to Russia crashed down to €122 million. In 2017, exports to Russia remained at the same level (€126 million).

The share of Russian food exports has, in fact, fallen from



Exports and imports of agricultural and food products (CN 01–24) in 1990-2017.
Source: Finnish Customs, Uljas database

the best years of 26–28%, down to 8%. Exports to other EU countries, in particular, have increased. In 2017, exports to France, the UK, Poland and Denmark grew the most. Exports to France and the UK more than doubled from the previous year, and the share of these two countries grew from 5% to 10% in a year.

Traditionally, more than half of Finnish food exports have gone to neighbouring countries but, following the Russian import embargo, the share decreased dramatically. In 2017, the neighbouring countries' combined share of food exports was just over 40% (Sweden 19.5%, Estonia 10% and Norway 2.8%).

Dairy products were still the most significant single product group in Finnish food exports. However, dairy exports are down from the top level in 2013 of €521 million to €347 million in 2017. The sector's share of total food exports in 2017 was just under one quarter, compared to a few years ago, when dairy products accounted for one third of exports. The value of butter exports in 2017 totalled €137 million, cheese exports only €47 million and whey exports €54 million.

Despite this, the dairy industry continues to be the only industry in the Finnish food sector that has maintained a positive trade balance throughout Finland's EU membership. However, the trade balance was barely positive following a dive from €160 million in 2013 to just under €16 million in 2016. In 2017, dairy products' balance of foreign trade increased to €48 million, thanks to growing butter exports.

The value of cereal export in 2017 was almost €109, which was €12 million less than the previous year. Oat exports remained at the level of the previous year (€56 million), and the combined exports of wheat and barley amounted to the same. Other key exports include meat, alcoholic beverages and products from the sugar and confectionery industries.

Finland's biggest trade partners in food export and import

	Export			Import	
	mill. €	%		mill. €	%
EU-countries	**1,093**	**77.2**	**EU-countries**	**3,396**	**65.2**
Sweden	307	19.5	Netherlands	725	13.9
Estonia	157	9.9	Germany	695	13.4
France	98	6.2	Sweden	542	10.4
Germany	81	5.1	Spain	316	6.1
Denmark	75	4.8	Denmark	303	5.8
Poland	63	4.0	France	204	3.9
Netherlands	61	3.9	Italy	191	3.7
Great Britain	53	3.4	Estonia	167	3.2
Lithuania	45	2.8	Belgium	166	3.2
Other countries	**359**	**22.8**	**Other countries**	**1,261**	**24.2**
Russia	126	8.0	Norway	326	6.3
Norway	45	2.8	Brazil	139	2.7
China	43	2.7	Costa Rica	73	1.4
USA	42	2.7	USA	62	1.2

Source: Finnish Customs, Uljas database.

Finland's first-rate food production methods offer a competitive edge

Csaba Jansik

It is often said that the Finnish food chain should not compete in the market of low-cost bulk food due to small production volumes and high costs. It would be more important to specialise in high-quality and high-priced products, as many background factors increase the quality and value of Finnish food. Key strengths were recently listed at the Ruokafakta (Food fact) website.[1]

Clean soil and water

The cleanliness of food products is affected by the purity of key production inputs, such as soil and water. The purity of arable land is based on the geochemical composition of soil and any substances added during the production process, such as manure, fertilizers and pesticides. Finland has the strictest regulations on the heavy metal content of fertilizers in Europe, and Finland has the lowest content of heavy metals released from sludge. The use of pesticides and herbicides per hectare is among the lowest in Europe.

The purity of water is a highly complex concept. Tap water is very clean in Finland but, in the light of EU statistics, differences between member states are very small. On the basis of results acquired from different measuring points in the Baltic Sea regarding the quality of swimming water, Finland is on an average European level along with other countries in Northern Europe. Unfortunately, the clean state of Finnish lakes and rivers cannot be distinguished from EU calculations. Instead, Finland has had the lowest nitrate content, an important key figure regarding groundwater that also has an impact on human health, on a European level.

In addition to the quality of water, the availability of water will be emphasised as a result of climate change. The scarcity of water is already a factor limiting agricultural production in many parts of the world. Finland and other Nordic countries have rich water resources in relation to the population. What is more, Finland is the first country with water accounting conducted at an accuracy of roughly 200 industrial fields. Understanding how we use water enables us to monitor its use and set separate goals for each field.

Clear signs of improvement can also be seen in the state of the Baltic Sea. Surveys of predatory fish in the Baltic Sea, conducted at intervals of a few years, indicate that, for example, the dioxin content in salmon has halved over the past 20 years, approaching the EU threshold value.

[1] The Ruokafakta website consists of roughly 30 different themes based on Eurostat, OECD, EFSA and other statistics, EU reports, different research results and the expertise of more than 50 researchers from 15 different institutions. The Finnish website opened in June 2018, and its English and Swedish versions will open in May 2018. Further information: www.luke.fi/ruokafakta

Achievements based on hard work

Finland's location in the north and northern climate undoubtedly cause additional costs in agricultural production. However, the status of plant and animal diseases has partly been better than in Continental Europe as a result of our isolated location across the sea. This means that leas pesticide and herbicide treatment is needed in plant production and medical costs are lower in animal production. Year after year, Finland has been among the countries with the lowest residues of pesticides and herbicides in food products. The use of antibiotics is the second lowest in Finland among EU member states, and Finland's status in terms of concrete bacteria, such as salmonella, has been exceptionally good.

When explaining these achievements, hard and persistent work, self-control of food chain actors and productive cooperation between organisations and authorities are much more significant factors than Finland's location and climate. In Finland, pesticides and herbicides or antibiotics are not used preventively, and safety periods and other guidelines and regulations are followed to the point. The current salmonella situation was preceded by research conducted over decades, as well as the active and independent commitment of companies and authorities.

Responsibility is indicated, for example, by the sustainability of fishing and fish farming. Phosphorus and nitrogen loads of fish farming decreased significantly after a switch was made to use powder produced from the Baltic herring in fish feeding.

Finland's food production chain promotes One Health

The overall responsibility of the Finnish food production chain is in line with the One Health concept. One Health defines that the health of people is closely linked with the health of animals and the environment. Key parts of the concept include food safety, diseases transmitted to humans from animals (zoonosis), the use of antibiotics and resistance to them.

In Finland, the wellbeing and good health of production animals enable the minor use of antibiotics, which has an impact on the state of the environment and the health of people. The volume of medical substances released into soil through the manure of production animals is lower in Finland than in other countries. Cases of zoonosis are rare and, most importantly, bacteria remain sensitive to antibiotics. In other words, the situation involving antimicrobial resistance is exceptionally good compared to other countries. The low level of resistance is a precondition for the functionality of antibiotics used by people. As a result, the production methods used in the Finnish food chain promote One Health, the simultaneous health of people, animals and the environment.

Strengths offer a competitive edge in national and international markets

The Finnish food chain produces clean and safe high-quality food. What kind of a competitive edge does this offer in national and international markets? Even though Finnish consumers value Finnish food products, the loyalty of many is based on conventional or vague conceptions. Facts are needed to increase the appreciation of food so that consumers can select the domestic option based on facts and reason. Similarly, facts offer a competitive edge in international markets. In international mar-

kets, such as Asia, product safety and cleanliness are valuable properties. Experience shows that figures of many countries lower than those of Finland can result in high sales, as long as marketing and communication are in place.

When it comes to improving the value of food and exports, it is important that the good production methods, cleanliness and safety of Finnish food products are communicated extensively. We need facts of our strengths based on international statistics and research results, on top of which we can build a national brand and marketing activities. To top it all off, every company must independently narrate their detailed achievements and stories. Our strengths are concrete. What we need to do now is to sharpen our marketing and sales.

2. Agricultural and food markets

2.1. Trends on the world market

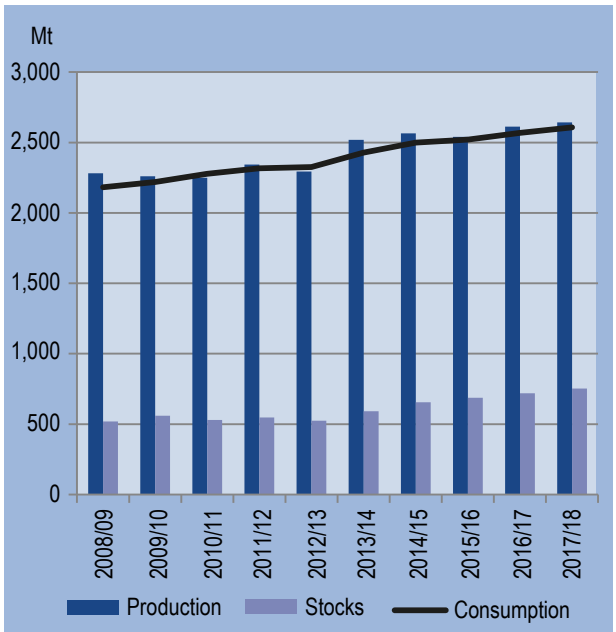
The global market for agricultural products has experienced rapid changes in the last decade. From 2007–2008, world market prices increased dramatically. In two years, the Food Price Index of the Food and Agriculture Organisation of the United Nations (FAO) rose by almost 60%. However, the strong growth was followed by a sudden drop in prices after the middle of 2008. In late 2010, cereal and other agricultural product prices on the world market shot up again, reaching their peak in early 2011.

Following the 2011 record high, the price of cereal kept falling steadily until 2016. In 2017, as the world economy picked up, demand for cereal increased, and this caused prices to rise. According to the price index of the FAO, cereal prices increased by 3.2% from 2016. However, prices remained more than 37% lower than in 2011.

In the 2017/18 crop season, world cereal production is estimated to amount to 2,642 million tonnes. This is just over 240 million tonnes, or around 15% more than five years ago.

Meanwhile, world cereal trade is estimated to amount to 405 million tonnes, which constitutes 15% of global production. Volumes in the world market have grown by more than 25% in the past five years.

Global wheat production remains at 757 million tonnes, which is down 0.2% on the previous year, but 16% more than it was five years ago. Global feed cereal production will grow to a new record, 1,383 million tonnes, representing an increase of 2.4% over the previous year's yield. In five years, production has increased by more than 20%.



Trends in world grain production, consumption and stocks in 2008/2009-2017/18. *Source: AMIS Statistics*

International wheat trade is expected to decline by 2.2% to around 173 million tonnes, representing 22% of global wheat production. Meanwhile, feed cereal trade is expected to grow by 1.8% to 185 million tonnes, representing 13% of the global production.

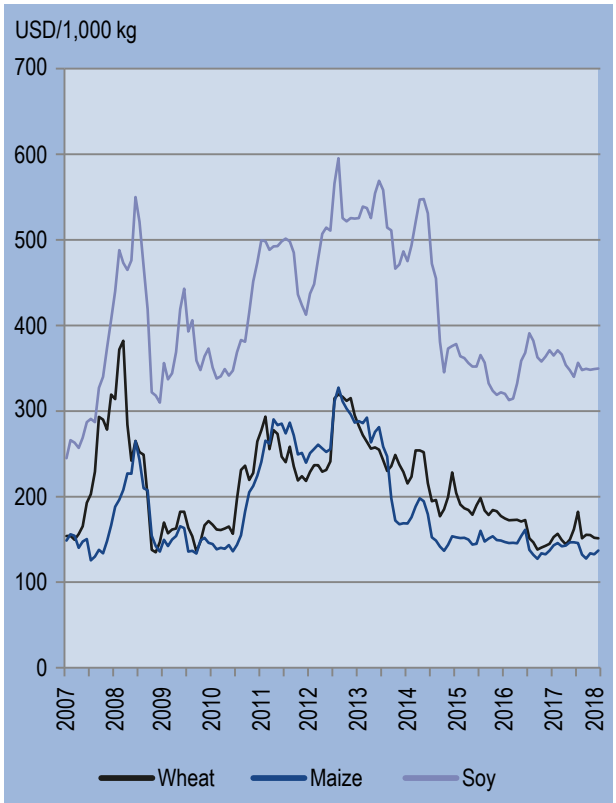
Global rice production will reach 503 million tonnes, the same as in previous years. Around 9% of total rice production, or 46 million tonnes, enters the global market.

Global oilseed production in 2017/18 is projected to total 574 million tonnes, showing growth of 0.5% over the previous year.

Soy production will decrease by 1%, remaining at 345 million tonnes. Globally, however, almost 30% more soy is being produced, compared to five years ago. Almost 45% of the production enters the global market.

Global cereal stocks have grown by almost 38% in five years and will amount to more than 750 million tonnes in the 2017/18 crop season. The expansion has increased the global cereal stocks-to-use ratio for wheat to almost 37%, for feed cereal to just over 22% and for soy to around 13%.

World sugar production is forecast to rise in the 2017/18 crop season to 190 million tonnes, which is up 8% on the previous year. There has been particular growth in production in Brazil, the EU and certain Asian countries. Global sugar trade amounts to almost 68 million tonnes, representing 36% of global production.



World market price for maize, soy and wheat in 2007-2017.
Source: USDA, CBOT, CBR

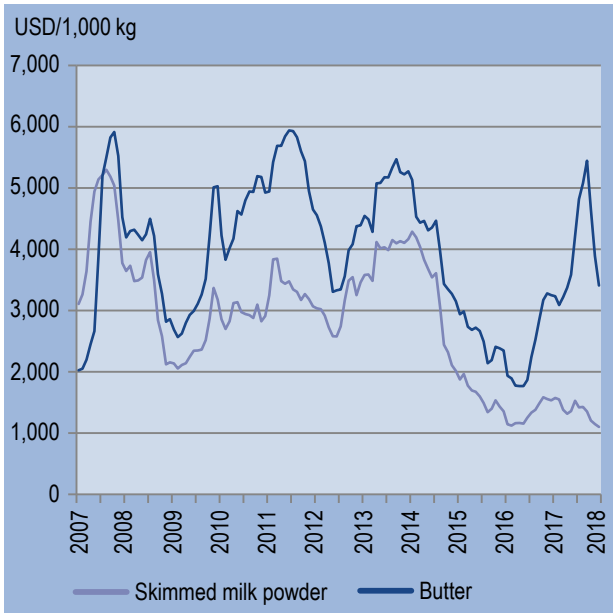
In the EU, growth in sugar production was the result of the abolishment of import quotas at the end of 2017. Today, sugar companies are allowed to produce as much sugar in each member state as they wish. This is forecast to increase sugar production and the export of sugar products in the EU in the coming years.

As a result of increased production, the world market price of sugar began to fall at the beginning of 2017. This was further enhanced by the weakening exchange rate of the Brazilian real. In 2017, the average price was more than 11% lower than the average price in 2016.

Global milk production in 2017 is estimated to have risen to almost 835 million tonnes, up by 1.4% on the previous year. In the world's largest milk producing country, India, production grew by nearly 4% to almost 170 million tonnes. The EU countries produced a total of 165 million tonnes of milk.

Global dairy product trade also continues to grow. Population growth, together with the increasing level of income, is boosting the consumption of milk products in Asia, in particular. In 2017, China, in particular, increased its imports of dairy products. Global trade represents around 8% of the global production of dairy products.

According to the FAO price index, the prices of dairy products in 2017 were up more than 30% on 2016, but still down almost 17% on 2013. 2017 will be particularly remembered for the steep increase in the price of butter. In the 2017 world market, the price paid for butter was al-



Export prices of butter and skimmed milk powder in 2007-2017.
Source: Canadian Information Centre

most double in comparison to 2016. This was partly due to the boom in natural products that spread from the US. Instead of margarine, people started to use butter in baking and frying.

Meanwhile, the price of milk powder was historically low in 2017. Thus, it would seem that the global demand is, once again, moving from protein to fats. However, the process is gradual, and the demand for milk powder is likely to remain fairly steady.

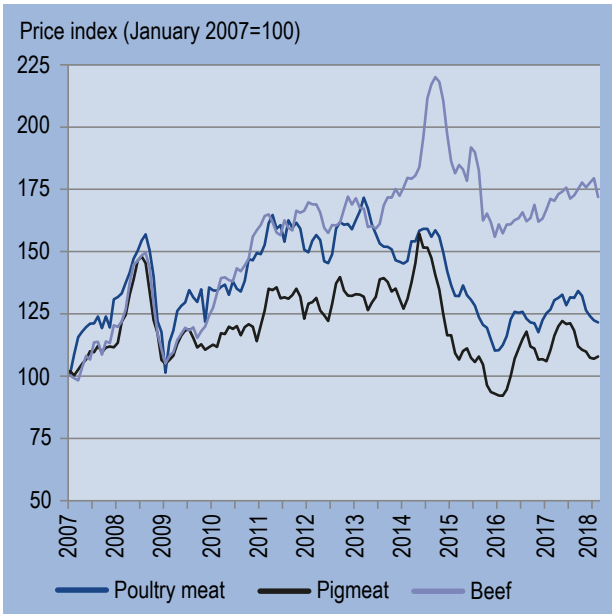
In late 2017, world market prices for dairy products took a downward turn, but began to rise again at the beginning of 2018. In April 2018, the FAO Dairy Price Index was 11% higher than a year ago.

Growth in global meat production has been modest in recent years. In 2017, production was an estimated 325 million tonnes. Growth from 2016 was 1.1%. Most of the growth occurred in the developing countries, where demand also grew the most.

In 2017, the international meat trade amounted to almost 31 million tonnes, representing just under 10% of global production. Globally, poultry accounts for more than 40% of the total meat trade, the figure for beef is just under 30% and for pork around 25%.

There are significant differences in trading between different types of meat. About 13% of beef production and 11% of poultry production is traded globally. For pork and lamb, this figure is 6–7% of the production.

According to the FAO price index, the prices of meat products in 2017 were, on average, up more than 9% on



World market price indeces for beef, pigmeat and poultry meat in 2007-2017.
Source: FAO

2016, but still down more than 14% on 2014. From 2011–2014, meat prices were remarkably high compared to historical levels. In late 2014, world market prices for meat took a downward turn. Prices continued to fall until the beginning of 2016, after which, prices were been rising again until the end of 2017. In April, meat products cost as much as they did a year ago.

2.2 Arable crops

In terms of arable crops, 2017 was a problematic year in Finland throughout the growing season. In general, the summer was cloudy and cool; spring sowing began and harvesting finished while it was snowing. Rain in the autumn had a negative effect on crop quality and caused delays and difficulties in harvesting as well as in other farming activities. The cereal yield was decreased by exceptionally widespread crop failure and decreasing areas of cultivation. In fact, the yield was the second lowest in the 2000s. Eastern and Northern Finland faced the worst crop failure in 30 years.

Areas and yields

In Finland, the utilised agricultural area comprises around 2.28 million hectares, of which around 0.86 million hectares are used to grow cereals. In 2016, the cereal yield was around 3,600 million kg, while in 2017, the yield was around 3,400 million kg, representing a fall of 4% in total cereal yield. The smaller sown area and the extensive crop failure are the main reasons for the second-lowest harvest in the 2000s. Then again, the per-hectare yields were higher than usual.

In 2017, 0.36 million hectares were used to grow barley, most of which (80%) was grown for feed. In 2016, the barley yield totalled 1,580 million kg, compared to 1,460 million kg in 2017, which is down 8% on the previous year. In 2017, the hectolitre weight of feed barley was 63.9 kg while malting barley was 68.4 kg. In 2016, 66% of the feed barley yield, or 850 million kg, was above the hectolitre weight of 64 kg, which is the minimum requirement commonly used in quality control. In 2017, the figure was 740 million kg. In 2016, 64% of the yield of malting barley (190 million kg) fulfilled the quality requirements regarding protein content and grain size set by the malting industry. The figure in 2017 was 88% (286 million kg).

Oats have a significant status among arable crops in Finland. In 2017, oats were cultivated on more than 0.27 million hectares. The oat yield totalled 1,014 million kg, which is almost the same as the previous year. The average hectolitre weight of oats was 57.1 kg. 97% of the oat yield, or 982 million kg, was above the hectolitre weight of 52 kg, which is the minimum requirement commonly used in quality control. 47% of the oat yield, or 473 million kg, was above the hectolitre weight of 58 kg commonly used for oats used for food. This figure is higher than the figure for the previous year. In 2017, DON toxins lowered the quality of the oat yield as, according to preliminary data, around one third of the samples examined exceeded the limits set for oats used for food. In addition, around 10% of the samples examined exceeded the higher recommended values set for animal feed.

In 2017, cereals used for making bread were cultivated on 0.22 million hectares in total. Of this, 160,000 hectares were used for spring wheat; 34,500 for winter wheat, and 28,900 hectares were used for rye. Of the wheat yield, spring wheat accounted for 649 and winter wheat for 153 million kg, bringing the total down 22 million kg (-3%) compared to 2016. In autumn 2017, the wheat yield was 802 million kg in total, of which only 14%, or 115 million kg, reached the hectolitre weight of 78 kg, the

falling number of 180, and the protein content of at least 12.5%. Due to the poor quality of wheat, it will be a struggle to meet the demand. In autumn 2017, the sown area of winter wheat was the smallest in 30 years due to poor weather conditions.

In 2017, the cultivation area of rye was 28,900 hectares. The total yield was up 31% on the previous year. The yield totalled 114 million kg, mainly because of a good per-hectare yield. The rye yield was the best since 1990 and will cover domestic demand. 42% of the rye yield, or 48 million kg, exceeded the hectolitre weight of 71 kg and the fall number of 120. In autumn 2017, the cultivation area of rye

Harvested areas and yields of main crops in 2016-2017

	2017			2016		
Crop	**Area** 1,000 ha	**Yield** kg/ha	**Total** million kg	**Area** 1,000 ha	**Yield** kg/ha	Total million kg
Wheat	194.3	4,130	802.0	215.1	3,830	823.9
Winter wheat	34.5	4,450	153.3	25.2	3,690	92.9
Spring wheat	159.8	4,060	648.7	189.9	3,850	731.0
Rye	28.9	3,920	113.5	26.0	3,340	86.8
Barley	358.3	4,070	1460.1	435.9	3,630	1580.7
Feed barley	284.6	3,990	1135.3	358.8	3,580	1282.7
Malt barley	73.7	4,400	324.8	77.1	3,860	298.0
Oats	269.5	3,760	1013.9	305.4	3,390	1035.1
Mixed crops	10.1	2,850	28.9	13.6	2,750	37.3
Grain total	**861.2**	**3,970**	**3418.4**	**995.9**	**3,580**	**3563.7**
Rape and turnip rape	55.2	1,650	91.3	60.4	1,540	92.9
Spring turnip rape	22.5	1,260	28.5	29.4	1,230	36.0
Spring rape	31.1	1,920	59.9	30.4	1,850	56.4
Winter rape and turnip rape	1.6	1,820	2.9	0.7	790	0.5
Linseed	0.4	1,180	0.5	1.5	1,070	1.6
Caraway	17.8	660	11.8	11.0	590	6.4
Potatoes	21.2	28,860	611.9	21.7	27,120	587.6
Sugar beet	11.8	36,550	430.3	11.6	37,340	433.6
Peas	4.2	2,180	9.1	10.2	2,470	25.1
Broad bean	16.1	2,090	33.7	16.0	2,500	39.9
Reed canary grass	3.0	4,550	13.5	3.5	3,110	10.8
Timothy seed	5.8	370	2.1	7.4	360	2.7
Hay	86.6	3,390	293.3	93.8	3,540	332.1
Silage	551.9	12,290	6783.5	511.4	15,510	7930.3
Prewilted	478.6	12,620	6039.5	458.7	15,790	7244.2
Fresh	73.3	10,140	744.0	52.6	13,030	686.1
Green fodder	8.9	7,240	64.8	12.0	7,330	87.6
Cereals harvested green	117.1	4,950	579.3	97.7	4,270	416.8

Source: Luke

was down to 22,000 hectares due to poor weather conditions.

In oilseed crops in 2017, the cultivation area of spring oilseed rape was 10,000 hectares more than the cultivation area of spring turnip rape (22,500 hectares). The total cultivation area of oilseed crops was around 55,200 hectares and the yield amounted to 90 million kg. The increasing cultivation of spring oilseed rape can partly be explained by higher yield levels. For example, the per-hectare yield of spring turnip rape was 1,260 kg/ha, while oilseed rape reached higher yield levels, 1,920 kg/ha in 2017. The cultivation of winter oilseed crops is minimal.

The cultivation area of broad beans is 16,000 hectares and the cultivation area of potatoes is 21,000 hectares. The broad bean yield was 34 million kg and the potato yield was 612 million kg. The cultivation area of sugar beet is around 12,000 hectares and the yield was around 430 million kg in 2017.

Grasses have a significant status in field cropping in Finland. In 2016, the cultivation area of silage totalled 0.55 million hectares and the total yield was 6,780 million kg, giving an average yield of 12,300 kg/ha. Most silage is harvested pre-dried. The cultivation area of hay is around 87,000 hectares and the total yield is 293 million kg. Pasture area amounts to around 58,000 hectares.

Market prices of cereals in Finland from 2009 to 2017, €/1,000 kg

	Rye	Wheat	Barley	Oats
2017	162	159	129	137
2016	169	151	124	130
2015	189	169	136	135
2014	196	170	132	125
2013	218	204	174	169
2012	214	203	187	186
2011	187	197	162	166
2010	160	147	113	116
2009	134	132	94	86

Source: Luke

Market prices for arable crops

Producer prices for cereals increased slightly as we moved from 2016 to 2017. The producer price of feed barley increased by around 5% during 2017, setting the average price at €129 per tonne. The price of malt barley increased more moderately than the price of feed barley, and the average price in 2017 stabilised at €155 per tonne.

The average quality-adjusted price of oats remained at €137 per tonne in 2017. The price was up 5% on the previous year.

The quality-adjusted price of feed wheat rose by 6% from 2016 to 2017. In 2017, the average price paid for feed wheat was €139 per tonne. At the same time, the increase in the price of bread wheat was slightly smaller, around 5%. In 2016, the average price paid for bread wheat was €151 per tonne, while in 2017, it was on average €159 per tonne.

Rye produced a good yield in 2017, but the price paid for it (€162/tonne) was down 4% on 2016. In 2016, the price paid for rye was €169 per tonne.

Oilseed crops have remained at a fairly good price level in recent years. In 2016, the average price of turnip rape and oilseed rape was €370 per tonne, while in 2017, it averaged €390 per tonne.

Market prices of cereals in 2016, €/1,000 kg

	Wheat	Rye	Barley	Oats
Finland	151	169		131
Germany	141	122		142
Estonia	146	117	128	105
Spain	157	135	151	158
France	201		213	350
Sweden	135	169	124	116
England	147	124	125	139

Source: Eurostat

In 2016, the price of food potato was €205 per tonne, and in 2017, it was €182 per tonne. The price of food potato fell during 2016, but started to pick up again in 2017.

Cereal prices in Finland are on the fairly low European level, despite high production costs. In Europe, prices in France have remained high and only the price of Finnish rye has been at a competitive level. On the domestic cereal market, prices have been slow to react to a rise in the price level, while a drop in EU prices has been quite rapidly reflected on the Finnish market. Strong fluctuations in prices have become a permanent feature of the cereal market, which means that farms should prepare better than previously for the market risks caused by these fluctuations.

2.3. Horticultural production

In Finland, horticulture is considered to comprise vegetable production in the open, the production of cultivated berries and apples, nursery production and greenhouses. In some cases, the cultivation of mushrooms and potato production under cover has also been included in horticultural production.

Cultivation areas and horticulture enterprises

In 2017, the total outdoor cultivation area for vegetables, berries and fruits was around 19,729 hectares. The area grew by 700 hectares from the previous year. There was growth in the production areas of outdoor vegetables, berries and apples. In 2017, the greenhouse production area was almost 390 hectares.

In 2017, there were more than 3,700 horticultural enterprises in Finland. Of these, almost 3,000 farms were engaged in the open and 1,100 farms in greenhouse production. Some of the farms had both outdoor and greenhouse production. In 2017, the average area of production in the open was 6.5 ha/enterprise and the average area of greenhouse production was 3,700 m2/enterprise. The average size of both enterprises engaged in outdoor production and those engaged in greenhouse production has continued to grow.

Satakunta and Southwest Finland are significant areas for vegetable cultivation in the open and North Savo is an impor-

Areas under the most important horticultural products grown in the open and yields in 2017.

	Area ha	Yield kg/ha	Total. 1,000 kg
Vegetables grown in the open			
Garden pea	4,037	1,758	7,096
Carrot	1,762	35,368	62,319
Onion	1,191	21,919	26,105
White cabbage	557	41,002	22,838
Cauliflower	291	10,684	3,109
Beetroot	420	24,371	10,236
Swede	420	29,598	12,431
Gherkin	165	43,836	7,233
Chinese cabbage	109	14,844	1,618
Other plants	2,851	4,871	13,888
Total	11,803	14,138	166,873
- share of contract production	1,951	25,764	50,266
Berries and apples [1)]			
Strawberry	3,800	3,628	13,785
Black and green currant	1,531	916	1,402
Raspberries and rapsberry-arctic bramble cross bred	429	2,497	1,071
Other berries	588	1,400	823
Total	6,348	2,691	17,081
- share of contract production	688	1,859	1,279
Apple	684	9,880	6,758

1) total area
Source: Luke, Horticultural Statistics.

tant berry production region. Most of the apple production takes place on the Åland Islands, Southwestern Finland and Western Uusimaa. Much of the greenhouse production of vegetables is concentrated in Ostrobothnia, in and around Närpiö in particular.

Weather conditions

The weather conditions in winter 2016–2017 were favourable for berries and no abnormal damage occurred during the winter. Southern Finland had almost no protective snow cover in the winter, but there were also no periods of extreme cold that could damage vegetation. This meant that the winter caused no significant damage.

In terms of horticultural plants, the weather conditions during the growing season in 2017 can be summarised as cold and late. The growing season began a week or two later than normal, with the cold spell in April causing a delay in the planting and sowing of early vegetables. The cold spring was also evident in fruits and berries flowering later than usual.

The summer was cold, causing further delays in the growth of horticultural plants. For example, onions were around one month late in the autumn and carrots were harvested a few weeks later than normal. The cool summer was particularly damaging to plants that require warm weather, such as corn and melon. They produced a harvest very slowly and the yield was poor.

The autumn weather was not much better for horticultural plants grown in the open. Abundant rain made the fields soft, and harvesting had to be postponed until the rain stopped. The wet harvesting conditions also made the produce susceptible to damage in storage.

Production in the open

In terms of area, garden peas are by far the most common vegetable. In 2017, peas were grown on 4,037 hectares. In terms of yield, however, the most important vegetable are carrots, with an output of almost 62 million kg. Other important vegetables were onions with a cultivation area of 1,191 hectares and cabbages with a cultivation area of 557 hectares. Outdoor vegetables were cultivated under production contracts on 1,818 hectares. The main vegetables cultivated for the processing industry were garden peas, carrots and gherkins.

Strawberries are by far the most significant berry plant in terms of both area and total yield. In 2017, the cultivation area of strawberries was just over 3,800 ha and the total yield was almost 14 million kg. Other important berries were black and green currants, cultivated on 1,531 hectares, and raspberries and a hybrid between the raspberry and the Arctic bramble, cultivated on 429 hectares. Berries were cultivated under production contracts on almost 690 hectares. Blackcurrants were by far the most significant berries cultivated under production contracts with the processing industry, representing 60% of the contract production area. In 2017, the cultivation area of fruits, mainly apples, totalled 745 hectares.

Greenhouse production

Greenhouse vegetables were cultivated on 217 hectares and ornamental plants

Areas under greenhouse vegetables (m^2) and yield (kg/m^2) in 2017

	Area 1,000 m^2	Yield kg/m^2	Total 1,000 kg
Total [1)]	2,215	39	87,322
Tomato	1,044	38	39,386
Cucumber	533	80	42,770
Other vegetables	638	8	5,166

[1)] Does not include potted vegetables.
Source: Luke, Horticultural Statistics.

on 121 hectares in 2017. The total output of greenhouse vegetables was just over 87 million kg. Measured in kilos, cucumbers and tomatoes are equally important greenhouse vegetables. In terms of area, tomatoes are clearly a more important greenhouse vegetable. In 2017, the cultivation area of tomatoes was 109 hectares and the total yield was 39 million kg. Around 34 hectares of the area is cultivated throughout the year, while the rest is only cultivated in the summertime.

In 2017, cucumbers were grown on 80 hectares, of which 23 hectares is cultivated in all seasons. The total yield of cucumbers was 43 million kg. The cultivation area of potted vegetables was 32 hectares. Most of the production area of potted vegetables is cultivated throughout the year. Lettuce is the most important potted vegetable, with a cultivation area of 25 hectares. The total number of potted vegetables produced amounts to 102 million.

The production of flowering potted plants declined slightly to around 10 million in 2017. The production of bulbous flowers fell from the previous year to 79 million. The most important potted plants were poinsettia (1.7 million) and winter-flowering begonias (1.2 million). Tulips were the most common bulbous flowers, with a total production of 73 million.

Organic horticultural production

The number of organic farms growing vegetables in the open rose slightly on the previous year to 176 farms in 2017. The yield of vegetables grown in the open totalled 3.8 million kg. In terms of yield, carrots are the most important organic vegetable, comprising 2.1 million kg. The number of farms growing vegetables in greenhouses fell slightly, but the production area increased slightly. The number of producers of organic berries increased slightly from the previous year to 244. In 2017, the cultivation area of organic berries also increased slightly on the previous year to 590 hectares. The total yield of organic berries was also up on the previous year, at 581,000 kg. In terms of both the cultivation area and yield, strawberries are the most important organic berry, comprising 169 hectares and 346,000 kg.

Horticultural product market

Strong seasonal and annual variations are characteristic of the producer prices and

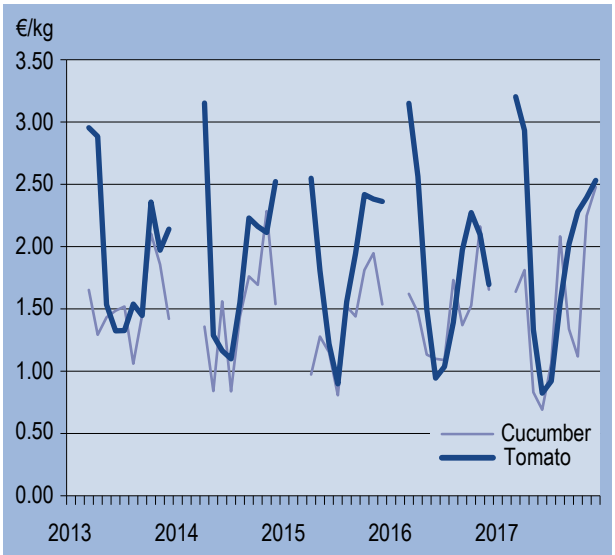
Produces prices for the most important horticultural products in 2009-2017, €/kg.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Greenhouse production									
Tomato	1.32	1.58	1.50	1.74	1.77	1.69	1.68	1.69	1.72
Cucumber	1.21	1.27	1.26	1.40	1.49	1.38	1.33	1.46	1.35
Production in the open									
White cabbage	0.42	0.49	0.48	0.52	0.65	0.62	0.54	0.60	0.57
Onion	0.43	0.56	0.57	0.56	0.69	0.65	0.56	0.63	0.72
Carrot	0.47	0.49	0.56	0.64	0.72	0.62	0.61	0.65	0.69
Strawberry	3.52	3.24	3.58	3.49	3.56	4.43	4.32	4.94	5.72
Apple	1.20	1.48	1.59	1.57	1.66	1.60	1.64	1.47	1.64

Source: Kasvistieto Ltd.

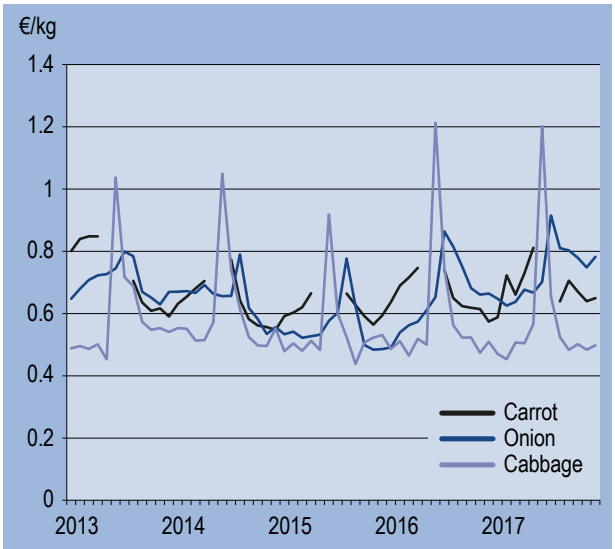
volumes of horticultural products grown in the open. Producer prices are typically low during the main crop season, when the domestic supply is high. The supply decreases during the storage period, which usually raises the prices.

Because of the challenging growth season, the supply of vegetables grown in the open remained limited throughout the season, keeping the prices of the products high. In 2017, the average price of onions, carrots, strawberries and apples was higher than the price for the previous year. The produce harvested was scarce and, in some cases, of poor quality. This may also increase the price of the products stored in early 2018.



Producer prices for greenhouse cucumbers and tomatoes from 2013 to 2017, €/kg.
Source: Kasvistieto Ltd.

Weather conditions affect the prices of greenhouse vegetables less directly than the prices of vegetables grown in the open. In early 2017, the price of greenhouse cucumbers remained at a good level partly due to scarcity caused by the replacement of vegetation. During the replacement period, part of the production area has been shut down as the vegetation is cleared, the area is cleaned and new plants are sown. The yield increased towards the summer and, during the summer, we saw the traditional price fall, as the market was flooded with fresh cucumbers.



Producer prices for certain vegetables grown in the open from 2013 to 2017, €/kg
Source: Kasvistieto Ltd.

Regarding tomatoes, the number of special varieties has increased, while the number of traditional, round tomatoes has decreased. This may partly explain the higher average price in 2017 compared to the previous year. In general, the price of tomatoes follows a similar trend to that of cucumbers. Early in the year, the price of tomatoes is high, falling quite steeply as the summer progresses, and rising again as we near the end of the year.

Return calculation of horticulture at current prices, € million.									
PRODUCTION IN THE OPEN	2009	2010	2011	2012	2013	2014	2015	2016	2017e
Vegetables	102.2	106.9	130.8	109.9	136.7	148.5	131.4	146.1	143.1
Berries and fruits	54.2	48.1	66.1	66.9	64.9	74.9	81.9	99.0	109.3
Nursery production	32.1	34.1	34.1	27.1	28.4	28.4	28.4	20.3	18.8
Total	**188.5**	**189.1**	**231.0**	**203.9**	**229.9**	**251.7**	**241.7**	**265.4**	**271.1**
GREENHOUSE PRODUCTION									
Ornamental plants	97.5	88.1	82.8	80.8	79.6	79.7	74.5	77.5	76.2
Vegetables	150.4	151.9	183.7	160.0	196.2	191.5	180.5	183.8	194.7
Total	**247.8**	**240.0**	**266.5**	**240.8**	**275.8**	**271.3**	**254.9**	**261.3**	**270.9**
Return at producer price, total	**436.3**	**429.0**	**497.4**	**444.7**	**505.7**	**523.0**	**496.6**	**526.7**	**542.0**
SUPPORT PAYMENTS									
Support for greenhouses	36.5	36.5	35.6	32.9	29.9	29.6	28.7	27.6	27.0
Storage aid for horticulture products	2.1	2.1	2.0	2.1	2.4	2.5	1.6	1.7	2.1
Environmental payment*	9.0	9.1	9.3	8.9	8.8	9.0	8.9	9.7	11.0
Basic payment**	3.2	3.3	3.4	3.3	3.2	3.3	1.1	1.1	2.2
LFA support	2.8	2.9	2.9	2.8	2.8	2.8	3.6	3.9	4.4
Other support***	0.9	0.9	0.9	0.9	0.9	0.9	1.0	1.3	1.3
Total	**54.5**	**54.8**	**54.1**	**50.9**	**48.0**	**48.1**	**44.9**	**45.3**	**48.0**
RETURN OF HORTICULTURE, TOTAL	**490.8**	**483.8**	**551.5**	**495.6**	**553.7**	**571.1**	**541.5**	**572.0**	**590.0**

**environmental support until 2014, **single payment until 2014, ***organic production and crop premium*
Sources: Luke; Finnish Agency for Rural Affaris; Kasvistieto Ltd; Finnish Glasshouse Growers' Association; Finnish Nursery Growers's Association

Return calculation

The return calculation of horticulture comprises the value of the crop produced at producer price and the calculated support payments for the horticulture production area and products in storage.

The horticultural returns, forecast at the market price for 2017, are €542.0 million, which is higher than the previous year. These higher horticultural returns are due to growing production areas and the fact that the prices of products remained at a good level.

The total revenue of greenhouse production increased on the previous year because of the good year in flower production and prices that remained at a good level. The value of greenhouse vegetable production also rose slightly, primarily because of the higher average price of tomatoes and cucumbers, when compared to the previous year.

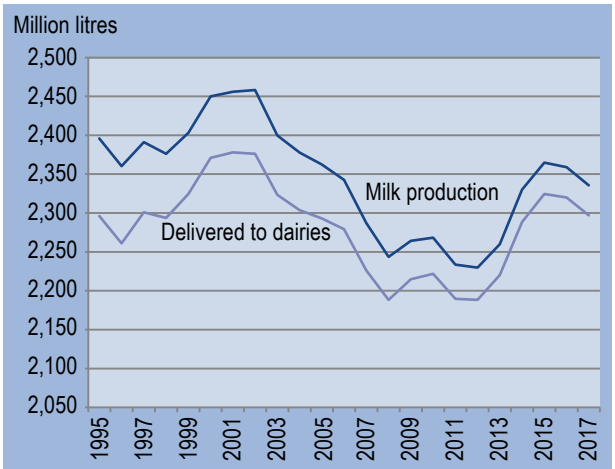
In 2017, horticulture received slightly more subsidies than in the previous year. This was mainly due to the increase in the outdoor production area.

2.4. Livestock production

Milk

The amount of milk delivered to dairies in 2017 totalled 2,297 million litres, 23 million kg (-1%) less than in 2016. Organic milk production accounted for around 63 million litres a year, which is up 14% on the previous year. Kantar TNS Agri estimates that milk production will fall to 2,285 million litres in 2018.

In 2017, the number of milk produc-



Milk production and the amount of milk delivered to dairies in Finland from 1995 to 2017.
Source: Luke.

ers decreased by 7%. Milk production was the main activity on around 7,300 farms. The number of dairy farms has declined by 37% (2,500 farms) in the last five years, but at the same time, the amount of milk delivered to dairies has increased by around 5%. Most of the farms that discontinued milk production were small farms with less than 20 dairy cows.

The number of dairy cows increased by almost two cows per farm in a year. A fifth of the farms had at least 50 cows, and almost half of all cows were on these farms. The total number of farms with more than 100 dairy cows was 338.

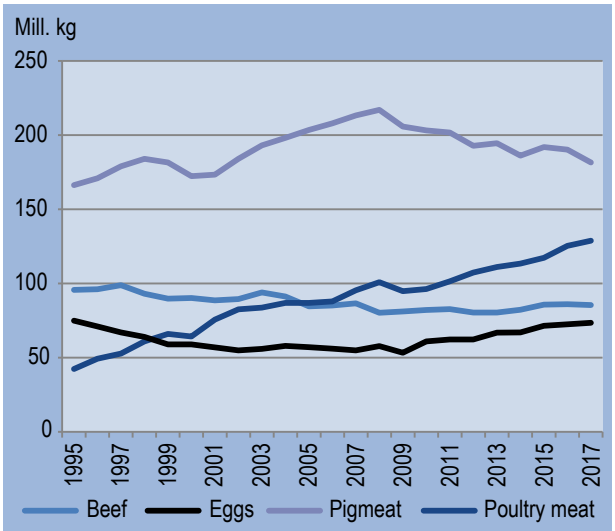
In 2017, the average milk yield of dairy cows rose by 1.5% to 8,534 litres per cow. In total, there were around 275,000 dairy cows, which is up 7,000 on the previous year. The number of heifers, around 150,000, was the same as the previous year. In 2017, just over 314,000 calves were born of which 128,700 calves were sold for rearing to other farms. Ninety-one percent of these were colostrum calves. The average weight of calves sold for rearing was just under 131 kg.

In 2017, altogether 623 million litres of liquid milk was packed, which is down 4.5% on the previous year. The production of skimmed and semi-skimmed milk decreased. Meanwhile, there was a clear increase in the production of full-fat milk. Buttermilk production was 48.5 million litres (-5%) and cream production was 45.8 million litres (+7%). Yogurt production was 106 million kg (-1%) and cheese production was 86 million kg (+3%). Butter production fell by 5% to 52.6 million kg. In Finland, almost 40% of the raw milk in dairy processing was used to produce cheese, just over 25% was used to produce milk, and just over 25% to produce butter and milk powder.

In 2017, the consumption of many dairy products fell. More than half of milk produced by the cows was consumed as cheese. In 2017, cheese consumption was 143 million kg (-3.1%), yoghurt consumption 110 million kg (-0.0%) and butter consumption 19 million kg (+0.9%). In 2017, liquid milk consumption was 611 million kg.

A significant part of the fat contained in the milk produced in Finland is used to manufacture export products. Over 70% of butter manufactured in Finland is exported. However, the protein fractions in milk are consumed mainly in Finland. Measured in litres of milk, the main export product last year was milk powder, which accounted for more than two thirds of total milk exports.

In certain product groups such as cheeses, a significant share of dairy products consumed in Finland is of foreign origin. Over the past 20 years, the consumption of imported cheese has increased by an average annual rate of 1–2 percentage units. It accounts for more than half of the total cheese consumption. Cream cheese consumption has also increased over the years, while consumption of aged cheeses has declined.



Production of beef, pigmeat, poultry meat and eggs in Finland from 1995 to 2017.
Source: Luke.

In 2017, the amount of imported cheese was 68 million kg (-9%) and that of exported cheese was 13 million kg (-19%). Milk imports were down and cream imports were up on the previous year, but the total amounts remained at the level of the previous year. The amount of exported butter and butterfat fell by 10% from 2016.

Beef

In 2017, meat production in Finland, including all farm animal species, totalled 398.5 million kg. Total meat consumption was 433 million kg, giving a 92% degree of self-sufficiency, which is lower than in the previous year.

In 2017, beef production was 85 million kg. The number of cattle slaughtered in one year was around 274,000. In 2017, the average slaughter weight of bulls was 351 kg, cows 288 kg and heifers 246 kg. Of the slaughtered cattle, around 50% were bulls, 30% were cows and 20% were heifers.

Beef consumption was 106 million kg, of which 24% was imported beef. Kantar TNS Agri has forecast that in 2018, beef consumption will be 105.5 million kg and production 85.2 million kg.

The number of farms specialising in beef production is around 3,350. Just over 2,100 farms raised suckler cows. Some farms raise both suckler cows and beef cattle. The number of suckler cows has more than doubled during the 2000s. According to the statistics, 58,000 suckler cows were kept in 2017, while the figure for bulls is 103,400.

In 2017, Finland imported a total of 25.8 million kg of beef (+20%) and 3.7 million kg was exported (-14%). More than half of the processed beef product imports still come from Sweden, where Finnish meat companies also operate. Of the total imports of carcass meat, imports from Poland, Denmark, Germany, the Netherlands and Sweden account for more than 86%. Most beef exports from Finland go to Sweden.

Pork

Around 2 million pigs are slaughtered in Finland every year. In 2017, the production of pork amounted to 181 million kg, which is down 5% on the previous year. Pork consumption amounted to 184 million kg (-3%). According to the Kantar TNS Agri forecast, pork production will fall to 179 million kg in 2018, while consumption will fall to 182 million kg.

In 2017, 1,160 farms were engaged in the pig sector as their main activity, which is down 13% on the previous year. Around 600 farms were specialised pig farms. In recent years, the number of pig farms has declined, on average, by 7–10% per year. Only the number of the largest farms has increased. These farms also account for the majority of production. More than half of all fattening pigs were raised on farms with more than 1,000 fattening pigs, although only one seventh of all pig farms fall into this category.

In 2017, the average slaughter weight of fattening pigs was 90 kg (+0.4 kg). The average slaughter weight of pigs has gone up by around 5 kg since 2008.

In 2017, pork exports amounted to 32.3 million kg (-15%) and imports to 32.6 million kg (-6%). Of all pork consumption, 18% was covered by imports.

Finland has traditionally exported carcass meat, but the share of meat pieces in exports has risen in recent years. In 2017, carcass meat accounted for 42% of total pork exports. Most of the exports were to the Baltic States, Sweden, New Zealand and South Korea. After extensive preparations, pork exports from Finland to China began in 2017.

Most of the imported pork came from Germany, Denmark and Spain. Most of the processed pork products come from Germany and Sweden. Germany accounted for 56% of total pork imports.

Poultry

In 2017, the production of poultry amounted to 130 million kg, which is an all-time record. Poultry production increased by 4% from 2016. The proportion of broiler meat in total poultry production was 94%. In 2017, broiler production was around 122 million kg (+4%) and turkey production was 8 million kg (+1%).

Poultry consumption has been steady increasing and it is estimated that it will continue to be strong. The market outlook for broilers in the next few years seems more favourable than for other meat production sectors, with a primary expectation of growth. According to estimates by Kantar TNS Agri, poultry production will increase to 126 million kg in 2018.

In 2017, broilers were raised on around 134 farms and turkeys on 53 farms. The number of broilers slaughtered was around 71 million and the average slaughter weight was 1.7 kg per bird. The number of turkeys slaughtered was 837,000 and the average slaughter weight was 9.6 kg.

In 2017, a total of 18.6 million kg of broilers (+4%) and 3.2 million kg of turkeys (+0%) were imported to Finland. Imports covered 14% of broiler meat consumption and as much as 32% of turkey consumption. Most of the broiler imports were processed products or boneless pieces. In contrast, most of the imported turkey comprised boneless pieces. The largest broiler producer countries are Thailand, Germany, the Netherlands, Sweden, Denmark, Estonia and Lithuania. Most of the turkey imports came from Poland and Germany, which are among the largest turkey meat producers in Europe, and from Brazil. Most of the imports comprised boneless pieces.

In 2015, broiler exports from Finland amounted to 15 million kg (-16%) and turkey exports to 1.7 million kg. Broiler exports accounted for 12% and turkey exports 21% of the production. Poultry exports consisted mainly of various bone-in or boneless pieces, as well as wings. Most of the broiler exports were to Estonia and Belarus, while most of the turkey exports were to Estonia and the Congo.

Eggs

In 2017, egg production amounted to 74 million kg, which is up just over 1% on

Livestock production in Finland from 2007 to 2017.

	Dairy milk million litres	Beef million kg	Pig-meat million kg	Eggs million kg	Poultry meat million kg
2017	2,297	85	182	74	129
2016	2,320	86	190	73	125
2015	2,325	86	192	71	117
2013	2,220	80	194	67	111
2012	2,188	80	193	62	107
2011	2,190	82	202	62	102
2010	2,222	82	203	62	96
2009	2,215	81	206	54	95
2008	2,188	80	217	58	101
2007	2,226	87	213	55	95

Source: Luke.

the previous year. 60% of class A eggs were produced in enriched battery cages, 34% were barn eggs, and 6% were organic. The number of eggs produced in enriched battery cages fell by 3%, while the number of barn and free range eggs increased by 8%, and the number of organic eggs increased by 16%.

Egg consumption has been steadily increasing in Finland over the last decade, amounting to 12 kg per person in 2017. The consumption of whole eggs in Finland was around 66 million kg, which is up 1% on the previous year. Egg imports were down by around 25%, which means that the share of imported eggs of total consumption was 5%. Egg products accounted for around 17% of total consumption.

In 2016, egg exports totalled 11.8 million kg, of which whole eggs accounted for 9.2 million kg and egg products just over 2.6 million kg. In 2017, total egg exports were down 2% on the previous year. However, the export of egg products was down 10%. Exports accounted for one sixth of total egg production and exported eggs went mainly to Sweden, Denmark and Germany.

In spring 2017, the number of egg-laying hens in Finland was 3.65 million (+2%). Meanwhile, the number of chicks was down by almost 30%, which is around half a million chicks. 1,045 farms kept egg-laying hens, but only 249 farms that specialise in egg production applied for agricultural support. More than 80% of all hens in Finland were kept on farms that stocked more than 10,000 hens.

Insects

Consumers and businesses are increasingly interested in the cultivation of insects and insect food. Insects provide a new source of protein in both food and feed production. In 2017, the interpretation of Finnish regulation was amended to allow the use of insects as food. Today, there are around 20-50 insect producers in Finland, and the sector is growing fast.

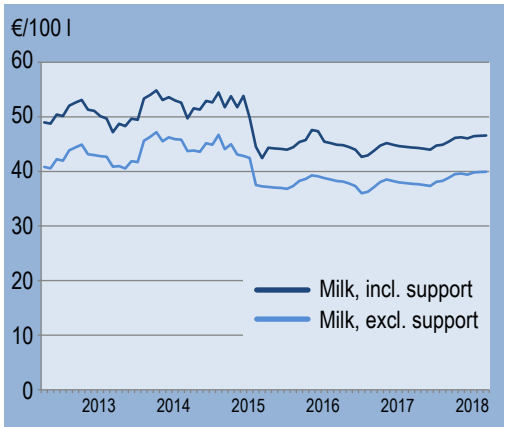
The producer prices of the most important livestock products in Finland from 2006 to 2017 including production support (€/100 kg, milk €/100 l).

	Milk[1]	Beef	Pigmeat	Poultry meat	Eggs
2017	38.81	298	148	133	96
2016	38.25	284	140	135	100
2015	38.64	290	146	139	102
2014	44.55	303	158	148	100
2013	47.27	310	174	154	117
2012	46.26	281	163	142	116
2011	43.90	253	146	131	96
2010	40.59	240	137	120	88
2009	40.11	247	141	124	87
2008	44.79	241	144	129	92
2007	39.05	221	132	114	77

1) The milk producer price comprises the price of standard milk which includes the quality of portion and other premiums but not production subsidies or quota payments.
Source: Luke

Producer prices

The market prices for livestock products in the EU influence their prices in Finland, but Finnish prices have certain spe-



Producer price of milk in Finland from 2012 to 2018.
Source: Luke

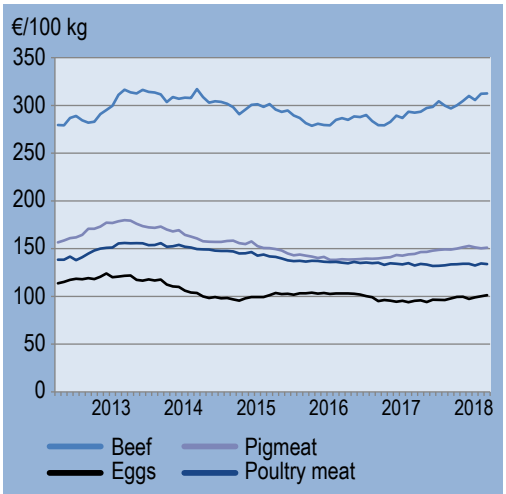
cial characteristics. The market prices for pork and milk, for example, vary less in Finland than in many other EU countries. Egg production in Finland has exceeded the demand, and the producer price has been low compared to other parts of the EU. The prices paid to Finnish milk producers have typically been slightly higher than in other parts of the EU on average, and in Finland the seasonal variation in prices is greater.

In 2017, the producer prices of poultry products declined from the previous year, while the producer prices of the other products under review here increased slightly. It seems that the milk and pork markets survived the restrictions imposed last year by Russia on food exports from the EU. Milk quotas were abolished in the beginning of 2015, freeing up the market for competition. However, the EU has taken adaptation measures in order to reduce milk production. In addition, pork producers have been concerned about the spread of African swine fever in the Baltic States.

In 2016, producers were paid, with all subsidies and deductions but excluding adjustment payments, an average of €38.25/100 l for milk, while the figure in 2017 was €38.81/100 l (+1%). In addition, an average 7.0 c/l was paid in 2017 as milk production aid. The final price of milk is determined when dairies complete their financial statements and the retroactive payments based on the results are determined.

In 2017, the average price paid to producers for bull meat was €3.40/kg (+3%). The average price of all types of beef was €2.98/kg (+5%). The price for heifer meat was €2.96/kg and for cow meat, €2.04/kg.

In 2017, the average price paid for a male colostrum calf was €161 and the price for a female colostrum calf €104. In 2016, the price of a male colostrum calf was up 17% and a female colostrum calf up 20% on the previous year.



Producer prices of beef, pigmeat, poultry meat and eggs in Finland excluding support from 2013 to 2018.
Source: Luke.

In 2017, the average price paid for pork was €1.48/kg, while the average price of fattening pigs was €0.02 higher. In 2017, the average price paid for piglets (30 kg) was €58.53. In Finland, the price of piglets did not take an upward turn in 2017 as it did in many Central European countries.

In 2017, the average price paid for poultry was €1.33/kg (–3%). The average price paid for broilers in 2017 was €1.29/kg. According to EU price monitoring, the trend in producer prices in Finland is more positive than in Sweden and Estonia. However, the product in the EU price monitoring (whole broiler, wholesale price) is not a good representation of the Finnish broiler market.

In 2017, the average price paid for eggs was €0.96/kg, which is down 3% on the previous year. The price of cage eggs fell by almost 10% during 2016. In 2017, the price paid for cage eggs was around €0.09/kg less and the price of organic eggs was around €1.60/kg more than the price paid for class A eggs on average.

Insects provide a new option for farm production?

Jarkko Niemi and Timo Karhula

Consumers and companies have shown rapidly increasing interest in insect farming and insects as food. The main uses of insects include as livestock feed, food products or non-food purposes. An entrepreneur entering the insect business should consider what their core, strength and product range are: food, feed or another area?

The insect sector is being promoted as an opportunity to create new side revenues for rural companies and to reduce Finland's dependency on imported protein. The trade can, for example, involve insect farming. Insect farming may represent a new direction if a farm transitions from traditional livestock production. Further refinement of insects can also provide opportunities in experience and food services. Given how new the industry is, farms considering transitioning to insect farming need concrete answers for how the process should be implemented.

Insects as food

Around two billion people around the world use insects in their nutrition, but in Europe, eating insects is a new phenomenon. In Finland, farming insects for food was boosted in November 2017, when the Finnish Food Safety Authority Evira indicated that the use of insects as food is possible in Finland under certain conditions. Only the use of farmed whole insects is allowed in Finland. While whole insects may be crushed, ground or dried, no parts (such as wings, legs or head) may be removed, isolated or extracted (e.g. fat or protein fractions) from the insect.

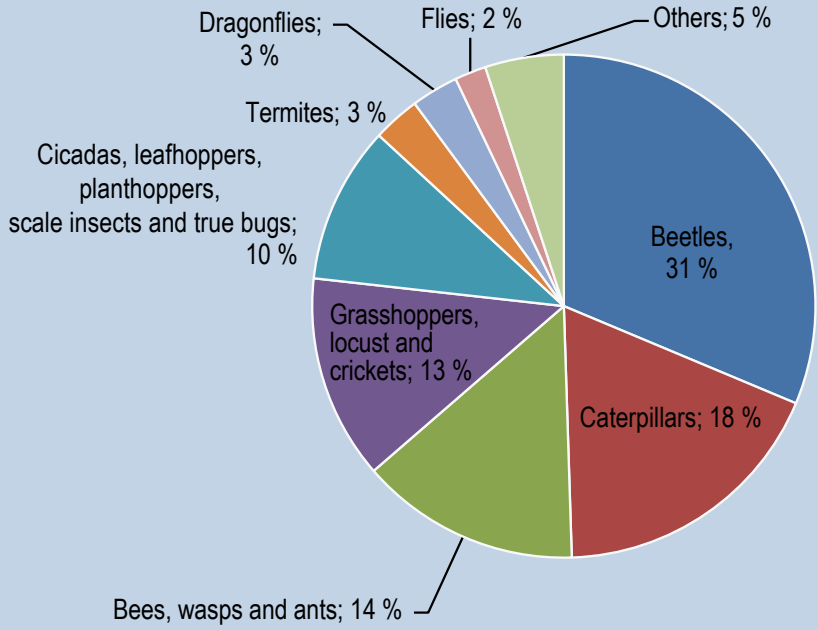


Figure 1. Species distribution of nearly 2,000 edible insects (van Huis et al. 2013).

All insect species that have been legally placed on the market as food in Finland or another EU member state before 1 January 2018 can be marketed in Finland between 1 January 2018 and 1 January 2019. All operators may sell and market these insect species and products derived from them as foodstuffs. An application for use as novel food also has to be submitted to the European Commission for these insect species by 1 January 2019 so that they can remain on the market after that date.

Currently, there are at least twenty active insect farmers in Finland. The insects are considered as farm animals. Globally, there are around 2,000 insect species that are edible. In Western countries, however, farming is concentrated on few, or at most, several dozen potential species.

According to Evira, insects permitted to be used as food include house crickets (*Acheta domesticus*), bees, honey bees (*Apis mellifera*), mealworm beetles, mealworms (*Tenebrio molitor*), tropical house crickets (*Gryllodes sigillatus*), buffalo worms (*Alphitobius diaperinus*) and migratory locusts (*Locusta migratoria*). Any species that may spread disease, are protected or are considered hazardous cannot be farmed.

Finns appear to be fairly open-minded towards insect food. According to a recent study, 70 per cent of Finns were interested in insects as food, and half were open to buying such products. Consumer attitudes are influenced by, for example, subjective and objective information, attitudes, product experiences and food-related fears. In order to increase consumption, it is important that there would be people who start consuming insects regularly after the products have been tasted.

Food safety is key

The safety of edible insects is emphasised in Finland and the EU. Breeders, manufacturers and retailers of insect food products are responsible for ensuring that the food products they sell are safe for consumers. Producers must ensure adequate hygiene and that packaging includes accurate and sufficient information on the properties of the food (e.g. allergens).

Evira has prepared guidelines for the food industry concerning the farming, sale and preparation of insects for consumption. The guidelines are intended for food control authorities, insect farmers and companies making foods from insects. Insect farmers can register as food business operators, whose activities are governed by food legislation and controlled by the authorities. Insect products produced this way may be marketed as foodstuffs.

The safety of insects' feed is an essential part of ensuring product safety. Feed materials of vegetable origin, mineral compounds, milk and egg products, hydrolysed protein and gelatine derived from animals other than ruminants, fish meal and former foodstuffs that do not contain meat or fish can be used to feed insects. It is not permitted to rear insects for use as food or feed by using waste or manure.

Possible food safety threats related to insects include various allergens, mycotoxins, pesticides, heavy metals and alkalis, and pathogenic micro-organisms (e.g. *Staphylococcus* and *Bacillus*, *Campylobacter*, *Enterobacteriaceae*, fungi like *Aspergillus* and *Fusarium*, etc.), that can be caused also by inappropriate handling of the products.

Insects as feed

The Feed Act regulates both feeding farmed insects and the use of insects to feed other animals. Insects can be used for feeding pets and fur animals almost without

restrictions, but the use of insect protein for food-producing animals is restricted. Insects can be used to feed aquaticc animals. Live insects can, however be used for food-producing animals other than ruminants. It is not permitted to rear insects using, for example, food waste or biowaste, manure, or other material that is deemed unacceptable as feed.

According to an experiment conducted during the Insects in the Food Chain project, chicken fed with insect protein (mealworm) (comprising 0, 10 or 15 per cent of the feed) grew more slowly than birds in the control group. International studies have found, however, that chicken feed containing 10 per cent insect protein did not affect production results. However, the impacts of amino acid supplementation, feed digestibility and composition on production results are yet to be determined.

Insect feed can be used as a replacement for fish meal, but attention should be paid for the composition of the feed. Another experiment involved replacing fish meal with mealworm in rainbow trout feed. When the fish meal content was below 12 per cent or the mealworm content was over 9 per cent, the feed factor and protein conversion efficiency began decreasing. Insect yields at harvesting decreased significantly only at high levels of mealworm in the feed. The results highlighted the differences in the digestibility of protein. According to the results, insect feed can, however, be used as a substitute for fish meal.

Non-food use

Other uses for insects include processing biomass (including biowaste and manure) and producing raw materials for industrial purposes. For example, the pharmaceutical industry is using certain insect-based ingredients. Flies are also efficient at processing manure. One of the species being promoted among insect farmers is the black soldier fly, the larvae of which are able to reduce manure mass by 50 to 80 per cent. Following manure processing, the larvae are a valuable fertiliser and soil improver, binding 70 per cent of phosphorus and 50 per cent of nitrogen. Larvae can also be used for manufacturing biodiesel, protein paste and sugars.

In Finland, the Animal By-products Regulation limits the use of insects in nutrient recycling and intermediate manure handling. For the circular economy, however, it would be important to promote the use of insects in manure and waste management, and energy production. A promising alternative would be to explore whether insects could be fed with waste while keeping insects farmed for use as feed and those farmed for use as food separated.

Heating and labour costs are challenges

While insect farming is still in its formative stage, operators in the sector are quickly gaining know-how. Insect farming involves several stages that are currently performed manually. The basic skills required in these processes, including skills related to feeding, care and rearing conditions, require further reinforcement.

The production cycle of insects is fairly short. For example, the house cricket, which is one of the the most commonly farmed insects in Finland, grows from hatching to slaughter in 46 to 59 days. At the beginning of the production cycle, adult crickets lay eggs in soil. After hatching, the crickets are reared for five to six weeks. Then they are culled, typically by freezing, and stored or transferred for further processing.

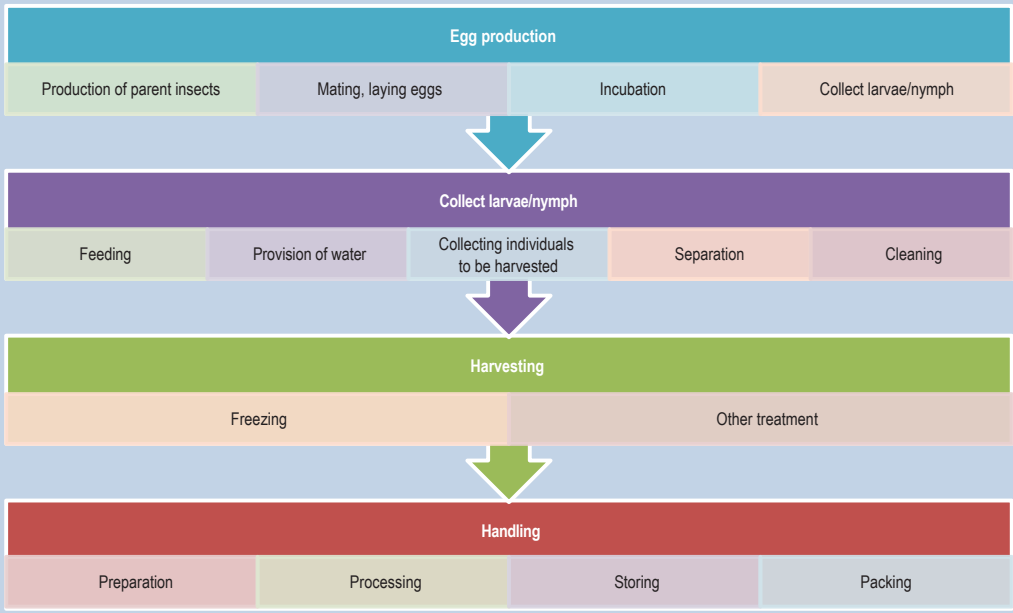


Figure 2. Insect manufacturing processes Source: Heiska and Huikuri (2017).

The use of insects in food and feed industries requires adequate ability. Indeed, large-scale production of insects requires solutions where the most labour-intensive production stages are automated, enabling production on an agricultural scale. As the sector grows, cost efficiency will improve. According to a domestic survey published in 2017, around half of the production costs of house crickets included labour costs, with fixed costs at 30 per cent and variable costs at 20 per cent, respectively. The most significant cost items included freight and feed. Currently, the small production volumes and the somewhat high cost level, which is partially caused by the lack of volume, are challenging for using insects as feed. For consumer markets, however, the profitability of the sector will likely depend quite heavily also on how insect food can be branded and which consumer segments are targeted.

According to studies, in ideal conditions, insects are able to use plant-based nutrition efficiently with little water consumption. Insect feed can be produced with commonly used feed material, such as cereals, broad beans or soy, supplemented with other feed material. From an environmental aspect, however, it is essential to find suitable side streams to feed insects that are not currently used in food or feed production. The protein and energy content of feed appears to impact, among other factors, the vitality of insects. According to relevant literature, feed similar to chicken feed with a minimum raw protein content of 20 per cent would be suitable for many insects.

In order to grow and produce offspring efficiently, cold-blooded insects require high ambient temperatures, which increases energy consumption. For example, house crickets thrive in tropical climates with temperatures around 30 C° and relative humidity of 60 to 70 per cent. In fact, up to 95 per cent of the greenhouse emissions of insect rearing may come from feed and heating energy.

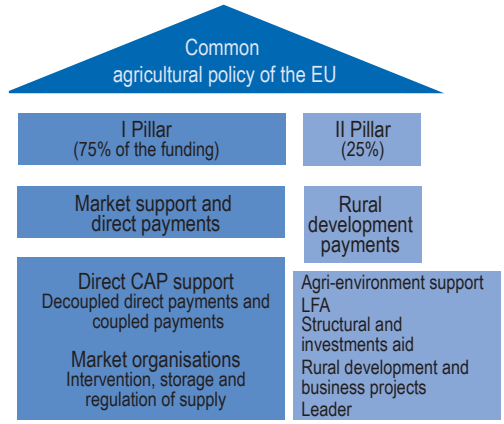
Furthermore, managing diseases, pests and related risks is essential for successful insect production. For example, viruses can wipe out the entire insect population of a farm very quickly. Adequate hygiene, controlled production conditions, and genome diversity maintenance and prevention of inbreeding help maintain a healthy insect population.

Source: Evira, Luke

3. Agricultural policy

Finnish agricultural policy is founded on the support schemes set down in the common agricultural policy of the EU, i.e. direct payments funded by the EU and the co-funded less-favoured area (LFA) and agri-environment payments.

In Finland, these payments are complemented by national aid that comprises northern aid, national aid for Southern Finland and certain other payments.



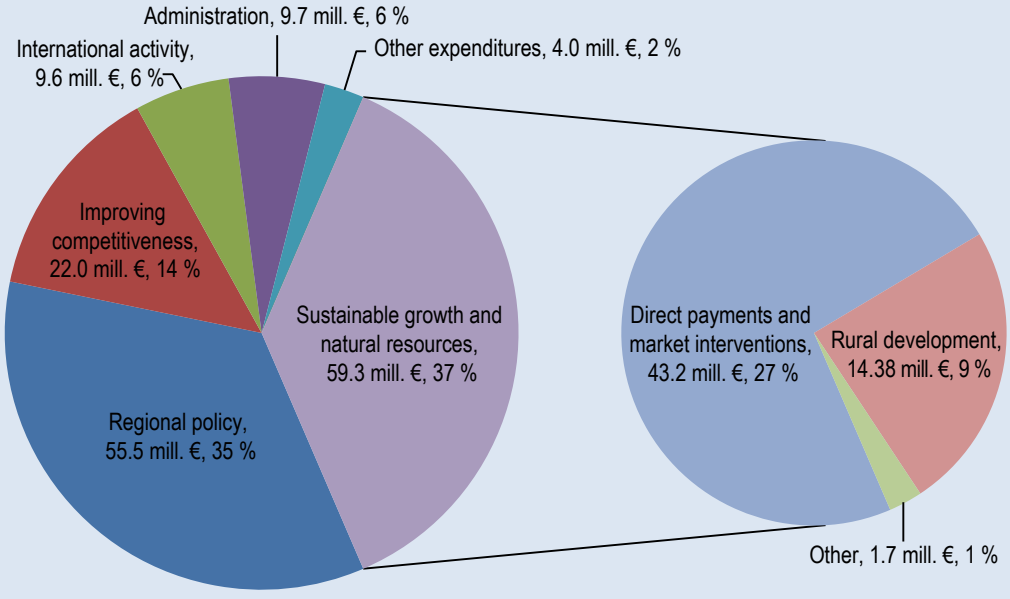
The structure of the common agricultural policy (CAP).

3.1. Common agricultural policy of the EU

The common agricultural policy (CAP) of the EU has been implemented for more than 50 years. From the very beginning, the main objectives were to improve the productivity of agriculture and balance the food markets, as well to secure the supply of food, a reasonable standard of living for farmers, and reasonable prices for consumers.

In time, these objectives have been supplemented by other aims, in particular, those relating to environmental issues, which reflect the societal demands that have arisen over recent decades.

The share of expenditure that arises from the CAP in the EU budget is considerably high, about 37% of the total budget in 2018. It should be born in mind, how-



EU budget for 2018, billion eur.

ever, that in the other sectors of the EU the integration does not go as wide and deep, and there is no common policy in the same way as is implemented in the agriculture sector through the CAP.

The CAP is comprised of the so-called first and second pillar. Most of the funding (75%) is allocated to the first pillar, mainly direct and market support. The smaller share of the funding (25%) is used for rural development measures under the second pillar (Rural Development Programmes, RDP).

As an outcome of the policy reforms during the past two decades, direct payments to farmers now constitute the lion's share of EU agricultural expenditure. In the early 1990s, most of the CAP funds were still used for export refunds for agricultural products and other market interventions.

CAP reforms since 1992

As a result of the policy reforms of 1992 and 1999, the intervention prices of agricultural products in the EU were lowered to be closer to the world market prices. The price reductions were compensated for by means of direct payments, which is why support payments based on arable area and livestock numbers gained a central position in the CAP.

In the policy reform of 2003, most of the EU payments for arable crops and livestock were transferred to the decoupled single payment scheme (SPS). At the same time, new conditions relating to the environment, maintaining the condition and productivity of the land, food safety, animal welfare, and occupational safety were incorporated into the scheme.

The reform of the EU's agricultural policies, dated November 2008, also known as the "Health Checks", continued the earlier reforms and strategic outlines, aiming to increase the market orientation of EU agriculture. Decoupled payments are now applied even more widely, and some of the remaining production restrictions have been abolished, to allow farmers to better respond to market demand.

CAP until 2020

Political understanding on the outlines and content of the CAP until 2020 was reached in June 2013. The European Commission, the EU Council of Ministers and the European Parliament were finally able to harmonize their views after two years of negotiations, which had become more and more intense, especially towards the end. Because of the new co-decision procedure and the long process of stakeholder consultation in 2010–2011, reaching an agreement took longer than had been planned, and the implementation of the new policy did not start until the beginning of 2015.

The new CAP includes the so-called greening of direct payments, and it aims for a more even distribution of payments among the Member States. However, most of the traditional main elements of the common policy have been retained, even reinforced.

The reform not only put an end to the trend for liberalisation that gained strength in the middle of the first decade of the 2000s, but in some respects, it actually "turned back the hands of time". In fact, the new policy allows some degree of re-coupling of EU payments to the production of certain commodities.

The reform also contains measures that aim to improve the supervision of the commercial interests of the producers and reinforce the position of producer organisations so that they have more negotiating power relative to the operators at the other end of the chain. The reform also gave the Member States the right to develop an insurance scheme and income stabilisation tool with EU co-funding.

Distribution of EU support for agriculture 2014–2020

The average annual budget for the EU agriculture policy for the programme period 2014–2020 is €51.8 billion. Even though the objective of the agriculture policy reform regarding the period 2014–2020 was to improve the equal distribution of aid, no significant changes occurred in the aid focus. Due to the stringent economic situation, cuts in the EU budget had more impact on the support received by the Mem-

Agricultural support per year in EU-28 by Member State on average in the programming period 2014–2020.

	Agricultural support. € million per year on average	Rural development payments under Pillar II. € million per year on average	Share of MS of EU agricultural support %	Share of subsidies in farm total output %*	Share of subsidies in farm net value added %*
France	8,899	1,416	16.0	12.7	42.9
Germany	6,243	1,174	11.2	12.9	43.8
Spain	6,056	1,184	10.9	13.6	27.7
Italy	5,275	1,490	9.5	11.1	21.5
Poland	4,593	1,563	8.2	15.5	52.4
Great Britain	3,944	369	7.1	12.4	51.6
Romania	2,973	1,145	5.3	10.1	24.8
Greek	2,584	599	4.6	21.1	47.2
Hungary	1,763	494	3.2	17.5	53.4
Ireland	1,525	313	2.7	20.6	58.2
Austria	1,255	563	2.3	17.6	56.8
Czech	1,183	310	2.1	21.7	74.9
Portugal	1,165	580	2.1	22.7	47.0
Bulgaria	1,116	334	2.0	21.2	50.1
Denmark	985	90	1.8	8.1	32.5
Sweden	948	249	1.7	15.9	65.9
Finland	**864**	**340**	**1.5**	**32.3**	**157.9**
Netherlands	839	87	1.5	3.6	12.9
Lithuania	706	230	1.3	21.0	65.1
Slovakia	659	270	1.2	20.4	79.4
Belgium	597	79	1.1	8.3	27.9
Croatia	534	332	1.0	18.8	57.9
Latvia	396	138	0.7	20.3	74.7
Slovenia	255	120	0.5	19.8	136.4
Estonia	253	104	0.5	17.5	85.1
Cyprus	68	19	0.1	12.4	38.1
Luxemburg	48	14	0.1	23.4	83.1
Malta	19	14	0.0	5.7	20.0
EU-28	55,747	13,620		13.4	39.3

*Source: Official Journal of the European Union L 347/655; Official Journal of the European Union L 347/487 *Percentages are based on the Farm Accountancy Data Network preliminary results from the year 2015 (http://ec.europa.eu/agriculture/rica/database/database_en.cfm).*

ber States. It was agreed that EU support for agriculture for 2014–2020 would be reduced by 5.9% compared to the funding period 2007–2013. Budget cuts particularly affected the second pillar, i.e. rural development funds, for which funding was cut by as much as 13% compared to the previous funding period.

The largest recipient of EU support for agriculture during the current funding period is France, whose share of all EU support for agriculture amounts to 16% (€8.9 billion). The second largest recipient is Germany (€6.2 billion) and the third largest is Spain (€6.1 billion). Finland's share of all subsidy payments for agriculture is some 1.5% (€864 million).

On average, about €13.6 billion is distributed annually in the EU as rural development payments, which amounts to 24% of all EU support for agriculture. The largest recipient of rural development funds was Poland (€1.6 billion) and the second largest was Italy (€1.5 billion). In relation to its size, Finland has traditionally received a significant amount of rural development payments. During 2014–2020, Finland will receive an annual average of €340 million of second-pillar support.

Support for agriculture has a significant impact on the total income of farms in the EU. The relative importance of EU support for income formation can be examined through the ratio between the subsidy payments and the farm gross return and net value added. In 2015, the share of agricultural subsidies of the farm gross return in the EU was 13.4% on average. In the EU, the percentage was the lowest in the Netherlands, where the share of agricultural subsidies was only 3.4% of the farm gross return. In Finland, the share was the highest in the entire EU. In 2015, agricultural subsidies accounted for almost a third (32.3%) of the farm gross return in Finland.

3.2. Payments of EU agricultural support in Finland

In 2018, the support for Finnish agriculture under the CAP will total €1,412 million. This consists of the CAP payments for arable crops and livestock (€524 million), less-favoured area (LFA) payments (€540 million) and environmental payments (€241 million). Additional support dedicated to organic production and animal welfare is also paid (€107 million). This is funded either by the EU alone or co-financed by the EU and Finland.

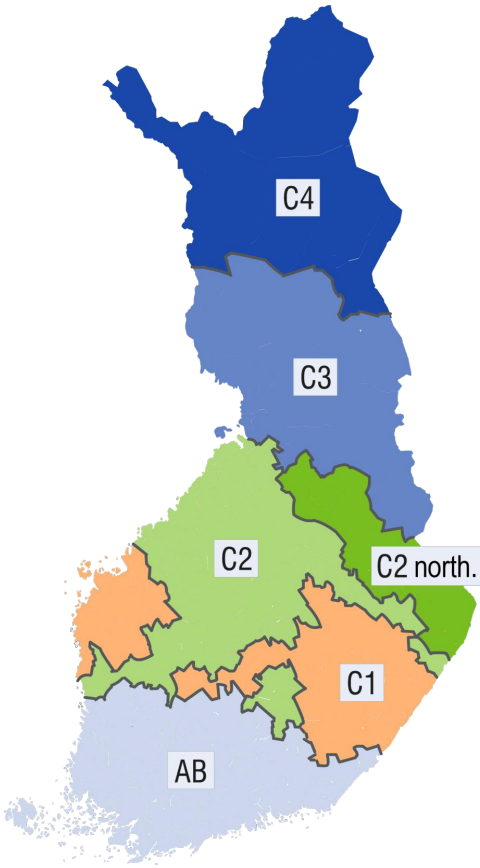
CAP payments are an integral element of the common market organisations and are funded in full from the EU budget. The EU contributes less than 20% of the LFA and more than 40% of the environmental payments. The rest is paid from national funds.

Besides the EU support, in 2018, about €323 million will be paid to Finnish farms as national aid. The national aid scheme comprises northern aid (€295 million), national aid for southern Finland (€23 million) and certain other national aid programmes (€5.5 million). As of 2015, national top-ups to LFA payments are paid as part of the EU LFA payments.

Before 2015, Finland was divided into three main support areas (A, B and C) for the allocation of payments. In 2015, the support areas were reduced to two (AB and C). CAP support, environmental support and LFA payments are paid throughout the country.

Northern aid is only paid in support area C. This has been divided into five regions for the differentiation of the aid. Support areas C3 and C4 are also divided into sub-regions. National aid for Southern Finland is paid in support area AB.

Because the agricultural policy of the EU was not designed for farming in northern conditions and mainly by small



Support areas in Finland.

farms, Finland has to pay for 56% of the necessary support for agriculture from national funds, while just under 44% comes from the EU agriculture budget. Still, Finland can be considered to have succeeded relatively well in obtaining EU funding for agriculture. In the period 2014–2020, the average annual EU payments to Finnish agriculture are around €864 million, of which around 39% are rural development payments.

In order to be eligible for most types of support, cross compliance is expected, meaning that farmers must comply with the basic standards. Cross compliance comprises standards for good agricultural and environmental conditions and statutory management requirements. The statutory management requirements refer to the environment, public, animal and plant health and animal welfare.

CAP support

Most of the so-called CAP support, financed in full by the EU, is paid in Finland through the single payment scheme adopted in 2013 (as of 2015, basic payment). In Finland, the payment scheme is implemented as the so-called hybrid model. Former CAP payments have been converted into payment entitlements, which consist of a regional flat-rate payment and farm-specific top-ups. In 2018, the value of the flat-rate payment entitlements in support area AB is around €122, and in support area C around €108 per hectare. Most of the farm-specific top-ups have already expired. In 2018, the value of the flat-rate payment entitlements in support area AB is around €122, and in support area C around €108 per hectare.

Along with the reform agreed upon in 2013, so-called greening measures, i.e. environmental measures that go beyond the base level, are included in the conditions for direct CAP payments as of 2015. 30% of the national maximum amount of direct payments of each country is reserved for greening. In 2018, the amount of support in support area AB is around €75 and in support area C around €65 per hectare. To be eligible for the payment, a farm must have at least two/three crops in cultivation, permanent pastures must be maintained, and at least 5% of the cultivation area must be left as an ecological focus area (EFA) in the regions of Uusimaa and Varsinais-Suomi.

The objective of support for young farmers, financed fully by the EU, is to make it easier to start a farming business and to ease structural development in agriculture. The support is paid for the first five years after setting up an agricultural holding, if the applicant has set up such a holding for the first time as head of the

Structure of CAP support from 2015.

Type of support	Status	Amount
Basic payment	Mandatory	Remaining share
Greening	Mandatory	Fixed 30% share
Natural constraint payment	Optional	Max 5%
Aid for young farmers	Mandatory	Up to 2%
Coupled support	Optional	Max 8% or 13%, optional 2% to protein crop top-up
Small farmers' payment	Optional	Max 10%

holding under the age of 40. In 2018, the amount of support paid for young farmers is around €53 per hectare.

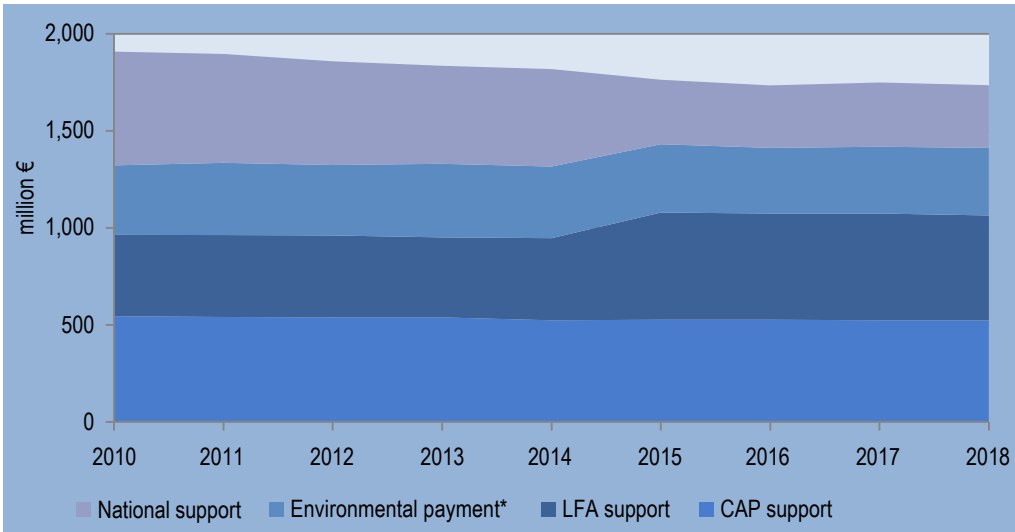
Part of the CAP support may be paid as coupled payments. The reform of 2013 allowed payments to be re-coupled to the production of certain commodities in the coming years. In Finland, the share of coupled payments of the total amount of CAP support rose to 20% in 2015. Coupled support is paid for suckler cows, bulls and ewes.

Less-favoured area payments (LFA)

Certain rural regions in the EU have been defined as less favoured areas (LFA). The purpose of LFA payments is to ensure the continuation of farming in these regions and to keep rural areas populated. In Finland, LFA support is paid for practically the entire cultivated area (2.16 million hectares).

The objective of the LFA payment is for agricultural production to continue in spite of the adverse climate conditions due to the northern location, the number of farms to develop in a controlled manner, and economically viable farming units to continue to exist, thus contributing to rural employment and promoting economic development in rural areas.

The whole of Finland is entitled to LFA payments. The maximum amount of the payment in the so-called mountain area, i.e. in Finland support area C in the north, is €450 per hectare, while in the



Agricultural support in Finland in 2010-2018, € million.

**Environmental payment also includes support payments to organic production and animal welfare.*
Source: Luke.

rest of the country it is €250 per hectare. In 2018, the payment for plant production farms is €217 per hectare in area AB, and €272 per hectare in area C, and for livestock farms €237 per hectare and €297 per hectare, respectively.

In 2007–2013, the average annual LFA payments in Finland totalled €421 million. The amount budgeted for 2018 is €540 million. The payment sum has increased because the national LFA payment (ca €120 million) has been paid as part of the EU LFA payment as of 2015. The EU contribution to the LFA payment in Finland is less than 18%.

Environmental payment

Agri-environmental support, introduced in 1995, compensates for income losses resulting from reduction in production and increased costs to farmers who commit to undertake measures aimed at reducing environmental loading caused by agriculture.

As of 2015, environmental support has been called environmental payment. At the same time, the scheme that comprised three types of measures (basic, additional and special measures) was replaced by measures targeted to specific parcels.

The environmental payment scheme strives to further the biological diversity of nature and to reduce emissions from agriculture into the air and waterways. The environmental payments are divided into the measure of nutrient balance, which is universally mandatory, and voluntary parcel-specific measures.

All farmers who are committed to the scheme must adhere to certain limits for the use of nitrogen and phosphorus in arable farming. Farm-specific measures deal with the use of manure and the promotion of biodiversity, among other things.

In the programming period 2007–2013, an annual average of €320 million was paid in environmental support. The

Agricultural support based on the Cap in Finland (financed in full and part-financed by the EU), € million.

	2012	2013	2014	2015	2016	2017	2018 estimate
CAP income support	**539**	**539**	**524**	**527**	**527**	**524**	**524**
Natural handicap payments	**422**	**412**	**423**	**552**	**547**	**550**	**540**
EU contribution	118	115	118	97	97	97	97
National financing	304	297	305	455	450	453	443
Environmental support	**363**	**379**	**369**	**255**	**236**	**241**	**241**
EU contribution	107	112	107	107	99	101	101
National financing	265	267	262	148	137	140	140
Organic production payment				**45**	**50**	**50**	**53**
EU contribution				19	21	21	22
National financing				26	29	29	31
Animal welfare payment				**52**	**52**	**53**	**54**
EU contribution				22	22	22	23
National financing				30	30	31	31
Total	**1,324**	**1,330**	**1,316**	**1,431**	**1,412**	**1,418**	**1,412**
EU financing, total	764	766	749	772	766	765	767
National financing, total	560	564	567	659	646	652	645

average share of the EU contribution to environmental support has been 28%. The funds for environmental support budgeted for 2018 total €241 million, of which €140 million comes from national funds. In addition to environmental support, a total of €107 million is paid as support for organic farming and animal welfare. Measures that support organic production and animal welfare are aimed at steering agricultural production toward more ethical and ecological practices.

The environmental support scheme is presented in more detail in Chapter 5.

3.3. National aid

The national aid paid in Finland comprises northern aid, national aid for southern Finland and certain other payments. The aim is to secure the preconditions for Finnish agriculture in different production sectors and parts of the country. The principles to be applied in determining the level and regional distribution of national aid were agreed in the EU membership negotiations. The aid may not increase production, nor may the amount of aid exceed the total payments before the accession.

Northern aid

The Accession Treaty of Finland (Article 142) allows for the payment of national northern aid in areas north of the 62nd parallel and adjacent areas, i.e., support area C. A little over 1.4 million hectares, i.e. 55.5% of the cultivable arable area in Finland, is eligible for this aid.

Northern aid consists of milk production aid and aid programmes based on the number of animals and cultivated area. The scheme also includes aid for greenhouse production, storage aid for horticultural products, wild berries and mushrooms and headage-related payments for reindeer.

Northern aid paid in 2018 will total around €295 million. The most significant types of aid are northern aid for milk production (€161 million) and northern aid based on livestock units (€78 million).

The effectiveness of the northern aid is evaluated every five years. The latest evaluation report was completed in 2016. It assessed to what level the objectives set for northern aid were achieved, and the feasibility and justification of the measures applied in the scheme. Based on the results, in 2016, the European Commission and Finland discussed the future development needs of northern aid.

The EU Commission's new decision on Finland's northern aid scheme came into force on 1 January 2017. The decision provides Finland with more flexibility in the implementation and monitoring of the aid. The recipients and types of northern aid remained the same.

National aid for agriculture in Finland, € million (aid per production year).

	2012	2013	2014	2015	2016	2017	2018 estimate
Total	534.3	504.9	502.1	332.1	322.3	330.9	323.2
Northern aid	328.2	317.4	314.7	296.5	285.7	300.3	294.5
National aid for Southern Finland	74.9	62.5	62.5	28.9	27.0	25.1	23.2
National supplement to the LFA support*	119.4	119.3	118.6	-	-	-	-
Other national aid	11.8	5.7	6.3	6.7	9.6	5.5	5.5

**Since 2015, the national top-up for LFA payments has been paid as part of the EU LFA payment scheme.*

National aid for southern Finland

National income aid is still paid to pig and poultry husbandry and horticultural production in Southern Finland. This is based on Article 214a. This legal basis under Community law to continue the payment of national aid for agriculture in Southern Finland was approved by the EU institutions in autumn 2013. In connection with this, the national income aid for Southern Finland decreased from around €63 million to around €29 million, and will decrease further to €17 million in 2020.

3.4. Structural support for agriculture and farm relief services

Structural support

The agricultural investment aid aims to promote growth in farm size by reducing production costs. In practice, these forms of structural aid comprise subsidised interest rates, subsidies and state guarantees. In 2018, the maximum amount of subsidised interest loans is €250 million. They are granted primarily for funding production buildings and to young farmers starting out, for acquiring real estate and stock. In 2018, the costs to the state from interest rate subsidies will total around €25 million.

In 2018, agricultural investments, the interest subsidy for interest rate subsidy loans and the state guarantee will be financed entirely from national funds. Setting-up aid for young farmers, on the other hand, will be partially funded by the EU. In 2018, €67.5 million was budgeted for young farmers' setting-up aid and investment support.

Farmers' early retirement schemes offers ageing farmers the opportunity to give up the farm. In 2018, the total retirement support is estimated to be €59 million. The early retirement scheme will end at the end of 2018.

Farm relief services

Farmers practising livestock production on a full-time basis are entitled to 26 days holidays per year. The Ministry of Social Affairs and Health is responsible for the management, control and coordination of the relief services. The purpose of the services is to ensure that farming activities continue uninterrupted during holidays, and that substitute help is available in the case of illness or accidents. In 2018, the funds used for the relief services to farmers will be around €145 million.

Number of objects of structural support and funds committed to these in 2012–2017.

	2012	2013	2014	2015	2016	2017
Number of decisions on subsidies	2,205	2,461	2,694	1,317	2,133	2,726
Building in dairy husbandry	363	376	319	116	255	311
Building in pig production	38	29	27	17	29	37
Horticulture investments	55	51	41	51	59	72
Production buildings	237	414	359	198	429	520
Land improvement and building	368	324	428	336	590	618
Number of setting-up aids	544	597	1,108	127	300	312
Funds committed, € million	73.1	92.2	92.3	52.8	96.9	119

Source: Ministry of Agriculture and Forestry

Digitalisation refines the food chain into ecosystems

Terhi Latvala

Digitalisation is the trend of the day in many industrial sectors. In agriculture and the food industry, it means the extensive use of digital technologies in different parts of the food chain. Digitalisation can improve cost efficiency in production and the real-time control of production and help to manufacture standard and traceable products. In addition to technology, digitalisation largely deals with data management: the collection and storage of data, streams of data, ownership of data and new uses of data.

Digitalisation is not a completely new addition to agriculture in that robotics related to feeding, milking and manure removal systems and computer aided air conditioning and lighting systems are already in use in animal husbandry. Furthermore, the wellbeing and health of individual animals can be monitored by means of digitalisation, also in larger production units. In cultivation, robots and drones increasingly carry out different work stages related to plant protection, pest control, harvesting, product packaging and other labour-intensive or hazardous tasks.

The cost structure of farms that make use of robots and digitalisation will change, as labour costs are replaced by equipment costs. At the same time, the nature of work will change radically from manual to automated production. Digitalisation also enables a whole new form of entrepreneurship in agricultural production – an industrial and closed form of production independent of weather conditions. The organic production of Finnish Silmusalaatti salads is a good example, as production facilities are located in a partly underground factory in the Helsinki region.

Organic salads efficiently without any natural light

The cultivation of Silmusalaatti is a combination of manual and automated production. The greenhouse is located in Vantaa, some 15 kilometres from the centre of Helsinki. What is special about the greenhouse is that it is partly located underground. The seeds used in Silmusalaatti are sprouted under the watchful eyes of a computer program that monitors the temperature, humidity and flow of air, the temperature and flow of water, as well as any mechanical stress. In the sprouting phase, salads are flushed with running water more than a hundred times. After this phase, sprouts will grow to their final sizes in boxes. Finally, the salads are subjected to light to start photosynthesis and provide them with their beautiful green colour.

Photo: www.silmusalaatti.fi/media.fi

In the packaging phase, only covers need to be added to the salad boxes. The location of the greenhouse in the Helsinki region and close to central grocery chain terminals reduces the need for transportation and minimises the distance travelled. In addition, digitalisation is present in the company's operations in marketing activities carried out in social media channels, real-time sales, shop-specific monitoring and electronic order, delivery and invoicing systems.

We need brave people who think outside the box

Digitalisation improves the entire food chain in many ways. It not only improves the efficiency of food production and the management of the supply and product chains, it also helps to place more focus on the customer and brings consumer information to the core of business activities. Better understanding of customer needs benefits producers, retail and consumers. In order to get the most out of digital technologies, IT and automation need to be deployed widely across different networks in the decentralised food sector.

As a result of digitalisation, future buying is expected to change significantly. Adding customised product data in user profiles in the interface between retailers and consumers, smart household appliances and their wireless control, digital grocery stores, augmented reality in packages and apps that offer excess food from restaurants are here to stay. What is more, this is largely about the adaptation of people and food sector organisations to new ways of doing things and to new tools. Digitalisation demands that organisations operating in the field start to think differently compared to their current practices.

Interactive platforms and business ecosystems

To share information between different parties, platforms are needed for producers to sell their products or services. When talking about the platform economy, Über, Airbnb, Alibaba, eBay and Amazon – typical major corporations – are often mentioned. Über, for example, offers a platform with which car owners can offer rides. Platforms are also seen to offer significant technological opportunities in the food chain.

Decision-makers and financiers should encourage different parties to co-create- and develop platforms. Platforms form new types of partnership and development networks (i.e. business ecosystems) into food networks and enable the development of consumer-driven operations. In addition, they also enable sharing information between agricultural producers, similarly to networking between other parties to the chain. As a result, many different operating models and business ecosystems specialising in their implementation can be developed.

Network-based solutions give birth to new digital marketplaces where small-scale entrepreneurs can find customers, also on a global scale. Interaction also increases understanding among producers of consumer needs and enables the development of customised options. It helps to productise immaterial values related to the entire raw material production chain, such as sustainable choices in the production process. In terms of business operations, there is, however, the big dilemma associated with the platform economy: When do platforms accelerate demand sufficiently and when do product ranges offered through different platforms start to increase? A functional platform ecosystem requires that people use services in a way that produces them value.

Moving forward with the help of incentive measures and research

The engagement of the Finnish food sector in the development of digital operating environments should be promoted. Path dependencies are often barriers to digitalisation, causing different parties to rely on their former selections, solutions and operating models. The food chain can be changed radically, but this requires systematic investments in the development of expertise and the infrastructure. For example, consumers and other parties to the chain can use shared digital development platforms to reorganise activities. Pilot projectsand demonstrations advance the development of the platform economy and help to identify the advantages of new operating methods in practice.

However, digitalisation and increased productivity in the food chain require not only new technologies, but also expert organisations that are ready for the change. This situation emphasises the ability of organisations to boldly change their activities and see the concrete impact on their organisation. In addition to study new products, production processes and business ecosystems, the role of research is to help companies to draw visions of their future activities.

The report prepared for the Prime Minister's Office recommends certain key actions to advance digitalisation in the food chain. Currently, the EU is strongly promoting the Digital Innovation Hub (DIH) agenda in order to increase the level of digitalisation in different sectors, such as agriculture and the food industry, as part of the strategy of Europe's digital single market. The engagement of the Finnish sector in the development of the expertise required and digital operating environments should be promoted. In addition, the food sector must advance the following in order to make use of digital key technologies: clarifying rules regarding rights to use and manage data, developing ways to identify and control the quality of materials and products starting from primary production, testing operating models that require new ways of thinking, developing technological expertise, and taking part in the construction of infrastructures that support changing operating environments.

This text is based on the "Digitalisaatio ruokaketjun kehittämisessä (Digitalisation in the development of the food chain)" publication prepared for the Prime Minister's Office and its Policy Brief.

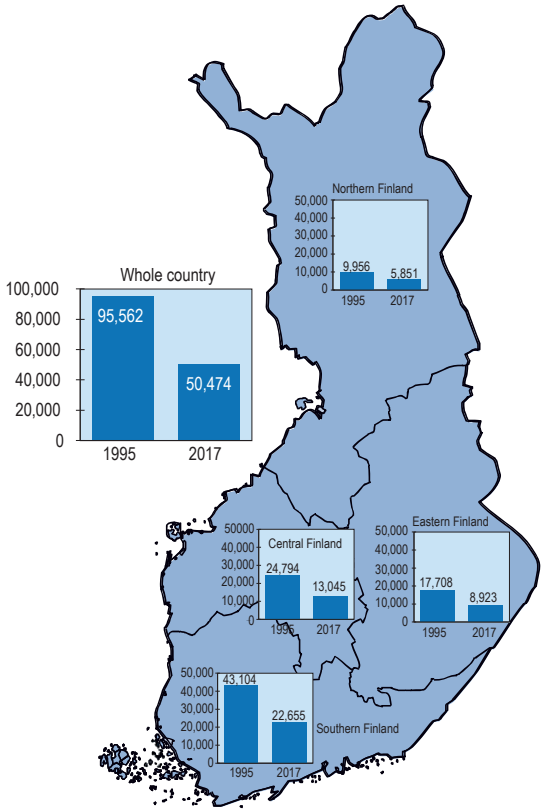
Source: Latvala et al., 2017, Latvala and Pesonen, 2017, Silmusalaatti 2018.

4. Structural development and economic situation of agriculture

4.1. Structural development of agriculture

In 2017, the total number of farms (over 1 ha) in Finland that had applied for agricultural support was just under 50,500. This number was more than 1,150 (2.2%) less than in 2016. In both absolute and proportional terms, the decrease in the number of farms was less than in 2016 and below the long-term average. During the 22 years that Finland has been a part of the EU (1995–2017), the number of Finnish farms has fallen by more than 47%, or 45,088 farms. On average, the number of farms has decreased at a rate of 2.9% per year. Proportionally, the decrease has been the greatest in Eastern Finland (almost 50%) and the smallest in Northern Finland (41%). In Southern and Central Finland (47%), the rate of change has corresponded to the national average.

As the number of farms has decreased, the average farm size has continued to grow. From 1995–2017, the average size of farms applying for agricultural support almost doubled from 22.8 ha of arable land to just over 45 ha. Average farm size is the smallest in Eastern Finland, where the share of the smallest farms is also larger than in other parts of the country. The share of farms with more than 50 ha of arable land is the largest in Southern and Northern Finland, where they make up around one third of all farms. Just under 50% of the 50+ ha farms, and more



Number of farms receiving agricultural support in 1995 and 2007 (main regions of Uusimaa and Åland have been included in Southern Finland.
Source: Finnish Agency for Rural Affairs.

Number of farms receiving agricultural support in 2007 - 2017.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Whole country	66,821	65,292	63,716	62,450	61,153	58,898	57,559	56,016	52,858	51,616	50,474
Southern Finland [1)]	29,945	29,368	28,694	28,098	27,578	26,517	25,874	25,119	23,726	23,167	22,655
Eastern Finland	11,812	11,501	11,218	11,033	10,808	10,479	10,281	10,027	9,469	9,141	8,923
Central Finland	17,574	17,119	16,650	16,177	15,771	15,172	14,812	14,410	13,645	13,322	13,045
Northern Finland	7,490	7,304	7,154	7,142	6,996	6,730	6,592	6,460	6,018	5,986	5,851

[1)] Main regions of Uusimaa and Åland according to NUTS II have been included in Southern Finland.
Source: Finnish Agency for Rural Affairs.

Size class distribution and average arable area of farms receiving agricultural support in 1995 and 2017[1].

	Southern Finland [2]		Eastern Finland		Central Finland		Northern Finland		Whole country 1995		Whole country 2017	
	Number of farms	%	Number of farms	%	Number of farms	%	Number of farms	%	Number of farms	%	Number of farms	%
Arable land												
<10 ha	3,736	16	2,042	23	2,323	18	1,050	18	22,850	24	9,151	18
10-20 ha	4,059	18	2,020	23	2,827	22	1,085	19	30,698	32	9,991	20
20-30 ha	3,066	14	1,251	14	1,909	14	733	12	19,669	21	6,959	14
30-50 ha	4,055	18	1,515	17	2,350	18	1,051	18	15,414	16	8,971	18
50-100 ha	4,816	21	1,411	16	2,437	19	1,188	20	5,706	6	9,852	19
>100 ha	2,844	13	659	7	1,138	9	735	13	784	1	5,376	11
Number of farms	22,576		8,898		12,984		5,842		95,121		50,300	
Average arable area, ha/farm	49.38		37.51		41.63		48.00		22.77		45.12	

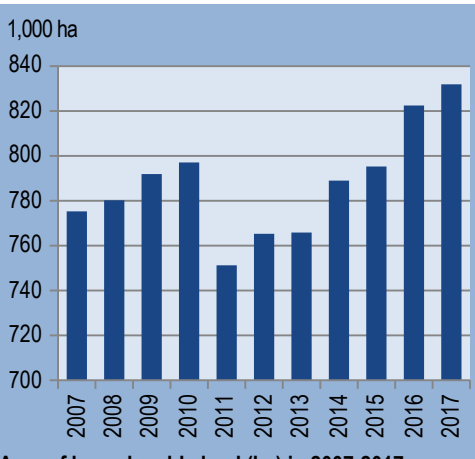
[1] The figures do not include horticultural enterprises if they have no fields under cultivation.

[2] Main regions of uusimaa and Åland according to NUTS II have been included in Southern Finland.

Source: Finnish Agency for Rural Affairs.

than 50% of the largest farms with more than 100 ha of arable land are located in Southern Finland. Almost half of the arable land is located in Southern Finland.

About half of the growth in farm size during the time of Finland's EU membership has occurred through leasing. In 2017, the total cultivated arable area of farms was 2,277 million ha, of which 831,829 ha (almost 37%) were leased. In 1995, the share of leased land was 22%. In the 2000s, the leased arable area has grown by almost 17%. There is considerable regional variation in leased land: in the Åland Islands, more than 51% of the arable land is leased, while the share of leased land in Central Ostrobothnia is less than 30%.

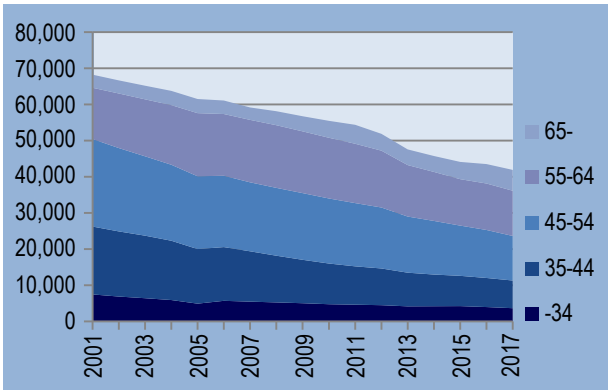


Area of leased arable land (ha) in 2007-2017.
Source: Finnish Agency for Rural Affairs.

Forests are an integral part of Finnish farms. In 2017, the average forest area of farms was nearly 54 ha. Regional variation is considerable, however: in Southwest Finland and the Åland Islands, the average forest area of farms is 34 ha, while in Lapland, it is 109 ha, and in Kainuu, it is 94 ha per farm.

Ownership of farms and age of farmers

Finnish agriculture is almost exclusively based on family farms: in 2017, almost 87% of the farms that applied for support were privately owned, and 11.3% were owned by heirs and family companies and corporations. Cooperatives and limited companies owned 1.6%, general and limited partnerships 0.2% and sole traders 0.1% of the farms. The state, municipalities, schools and parishes owned 0.08 % of the farms,



Number of farmers by age categories in 2001–2017.
Source: Luke

and the share of foundations, associations and the like was 0.06%.

The average age of farmers on farms receiving agricultural support was 52.9 years in 2017. The average age of farmers was the highest, 54.2 years, in the Åland Islands and the lowest, 51.8 years, in Central Ostrobothnia. As the farm population ages, the share of young farmers has fallen, while that of older farmers has increased. In 2001, 26% of farmers on privately owned farms were aged over 55. In 2017, their share was almost 44%. During the same period, the share of farmers aged below 44 fell from 38% to less than 27%.

Production structure of farms

The production structure of farms has undergone a significant change, as the number and share of livestock farms has decreased, while the share of crop farms has increased. In 2017, 24% of the farms that applied for support were livestock farms and 71% were crop farms, while in 1995, the share of livestock farms was 52% and that of crop farms 39%.

In 2017, less than 7,300 farms practised dairy husbandry as their main activity. from 1995–2017, the number of dairy farms fell by more than 24,700 farms, at the rate of 6.5 % a year. The share of dairy farms of all Finnish farms has also decreased: in 1995, dairy husbandry was the main activity on almost 34% of the farms receiving agricultural support, but in 2017, their share had fallen to less than 15%. Proportionally, the number of dairy farms is the highest in Eastern and Northern Finland, where they account for one quarter of the farms. Dairy farms are more evenly distributed across all regions of Finland than the other lines of production.

In 2017, around 3,350 farms specialised in beef production. That is less than 7% of all farms that applied for agricultural support. From 1995–2017, the number of these farms fell by more than 5,700 farms, at a rate of 4.4% a year. In 1995, 9.5% of all farms specialised in beef production. The distribution of beef farms across the country is quite similar to the regional distribution of dairy farms.

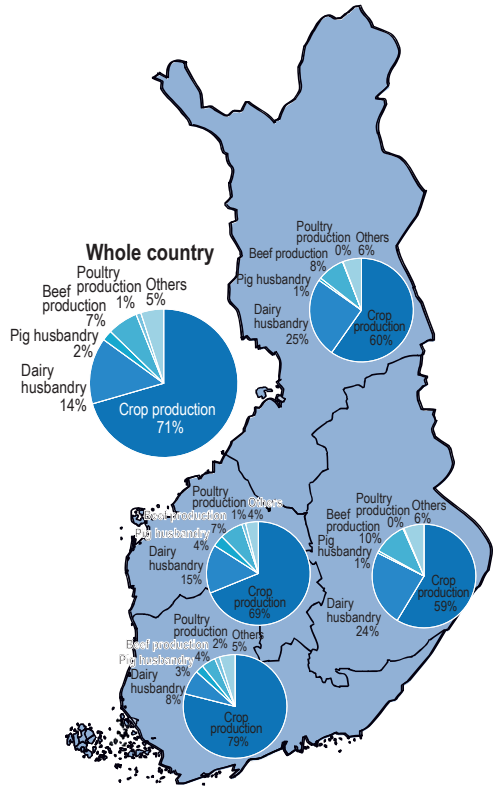
The number of farms specialising in pork production was about 1,160 in 2017, representing 2.3% of the farms that applied for support. Of the pig farms, 266 specialised in piglet production, 505 farms in pork production, and 386 farms practised combined pig production. In 1995–2017, the number of pig farms decreased the most compared to other production sectors: by more than 81%, or by 7.4% per year. The number of farms specialising in pig farming fell by 6% from 2016. The number of farms specialising in piglet production took the steepest fall, 12%. Pork production is focused in Southern and Western Finland.

The number of poultry farms was 531 in 2017, which comprises 1% of the farms that applied for support. During the period of Finland's EU membership, the number of poultry farms has fallen by 76%, at an annual rate of 6.3%. The biggest fall was in the number of farms engaged in egg production and other poultry pro-

duction, such as hatching egg production. In 2017, the number of farms specialising in egg production was 249, the number of farms specialising in poultry production was 216, and 66 farms were breeding units. Most of the poultry farms are located in Southern and Western Finland.

In 2017, there were just over 35,500 crop farms, which is only 1,706 farms (4.6%) fewer than in 1995. Following years of growth, however, the number of crop farms has taken a downward turn. In recent years, the number of farms only engaged in other crop production (e.g. hay) has increased. The number of these farms was up 2.3% on 2016. Half of the crop farms are located in Southern Finland, but in recent years, the share of crop farms of all farms in the area has grown the most in Eastern and Northern Finland.

The number of other types of farms was just over 2,500 in 2017, which is 5% of all farms. Over the past 20 years, their number has fallen by more than 71%, at an annual rate of 5.5%. Other farms include those engaged in horse, sheep or goat husbandry, and those engaged in other types of production or activities (e.g. farm tourism). After a period of growth, the number of farms engaged in horse husbandry has also decreased in recent years.



Distribution of farms receiving agricultural support according to production line in 2017 (main regions of Uusimaa and Åland according to NUTS II have been included in Southern Finland).
Source: Finnish Agency for Rural Affairs.

4.2. Development of results and profitability in agriculture and horticulture

The profitability in Finnish agriculture and horticulture is examined using the results of Luke's bookkeeping farms. The data from around 800 bookkeeping farms are weighted so that they indicate the average results of the 34,500 largest agricultural and horticultural enterprises. These account for more than 90% of the output of Finnish agriculture. In calculating the results, individual revenue and expense items are allocated to the year of production, in accordance with the accrual principle. Thus, yields, production volumes and returns, and changes in prices and support payments are directly reflected in annual profitability figures.

Farm size increases, while total return decreases

A farm's total return includes the value of the products sold and the subsidies received during the year, as well as the change in the products and supplies in stock, and the value of feed produced and used at the farm, i.e. the value of farm use. Farm use refers to the value of the feed or cereal produced on the farm and used to feed the livestock or the val-

ue of the cereal used as seeds. In 2016, the total revenue per farm averaged €150,600, with a decrease of around 3% from the previous year. In this decade, the highest total revenue, €158,100, was recorded in 2014. In 2006, the total revenue was €108,000 per farm. From this, the increase in total revenue is €41,800 (39%) per farm. In the same period, the average cultivated area per farm increased from 48 to 63 hectares and the number of animal units rose from 25 to 28. According to a forecast, the total revenue in 2017 grew by 1% from the previous year, to €152,500 per farm.

Total revenue has continued to grow slowly throughout the decade from 2006 to 2016, but the growth stalled or took a downward turn in all production lines at the end of the decade. The effect of the increasing farm size and the structural development on total revenue has been hidden by the falling producer prices, as producer prices took a downward turn from 2012–2014, following a period of increasing prices.

In terms of the share of direct support of total revenue, there is great variation between farms representing different production lines. In recent years, the average share of support has been around one third of total revenue, which is slightly down (2–3%), compared to the beginning of the ten-year period. In 2016, the share of support was the largest in sheep and goat farms (62%) and cereal farms (55%). The share has varied by a few percentage units from one year to the next due to changes in support systems, but also because of variation in yields and prices. In 2016, the share of support of total revenue was the smallest in greenhouse enterprises (7%) and poultry farms (10%). Here, the share of support has more than halved, compared to the situation ten years ago.

Entrepreneurial income halved in a decade

Entrepreneurial income is the part of a farm's total revenue that is left for farmers (entrepreneur) for their work and own capital invested in their business activities. Thus, all costs excluding the wage claim on own labour and the interest claim on own capital are deducted from total revenue. Entrepreneurial income can be used to cover the needs of the farmer's private household. If the objective is to continue farming, and the depreciation of assets is used to finance replacement investments, the entrepreneur will not, in the long term, be able to withdraw for own use more than the entrepreneurial income from the farm profits.

Entrepreneurial income per farm (figures 1 and 2) was €11,200 in 2016. Compared to the situation ten years ago, the figure is down €9,000. Despite increasing farm sizes, entrepreneurial income has halved. In the long term, the increase in input prices has been greater than the increase in producer prices. This has eaten away a substantial portion of the potential increase in entrepreneurial income generated by structural development and improved production efficiency. Variation in yields also cause annual changes in entrepreneurial income. The lowest entrepreneurial income, less than €1,000, was earned in cereal farms and sheep and goat farms. Variation among farms is great, but even the most successful cereal farmers only make an entrepreneurial income of €16,000. In terms of total revenue, greenhouse enterprises are the largest, with an entrepreneurial income of €62,200 in 2016, which is considerably higher than in other production lines. Greenhouse farming and poultry farms are the only production lines with a clearly higher entrepreneurial income (55% and 70%), when compared to the levels ten years ago.

Work has been replaced by capital

In the point of view of entrepreneurs, entrepreneurial income is a key indicator but, alone, it does not indicate the profitability of operations. Other factors, such as the farming family's capital tied up in the business operations, and the value of their labour contribution must also be accounted. In 2016, the farming family's average labour contribution per farm was 1,880 hours. The trend has been decreasing in the past ten years (-22%). The biggest labour contributions were made on milk farms (4,150 hours) and in greenhouse enterprises (3,390 hours).

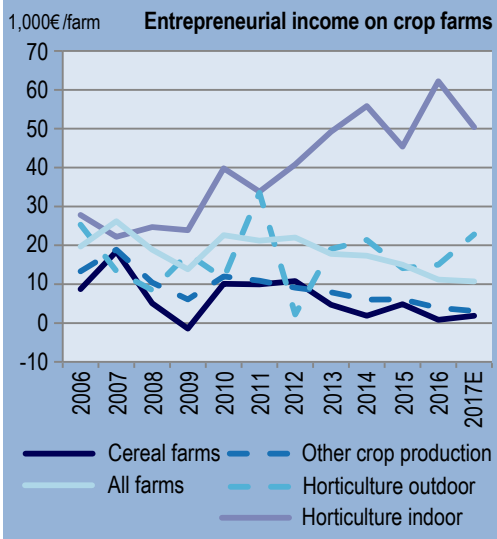
The amount of own capital invested in business operations by farming families has been on the increase throughout the 2000s. It has increased by 52% from 2006 to €338,000 per farm in 2016. The strongest growth has been seen on livestock farms. In the past few years, however, the growth of own capital has stalled to virtually a standstill. The largest amount of own capital is tied up in pig farms (€743,000) and in poultry farms (€590,000). Increase in liabilities has been only slightly slower than in own capital and, throughout the ten-year period, the equity ratio has remained at around 72–75%.

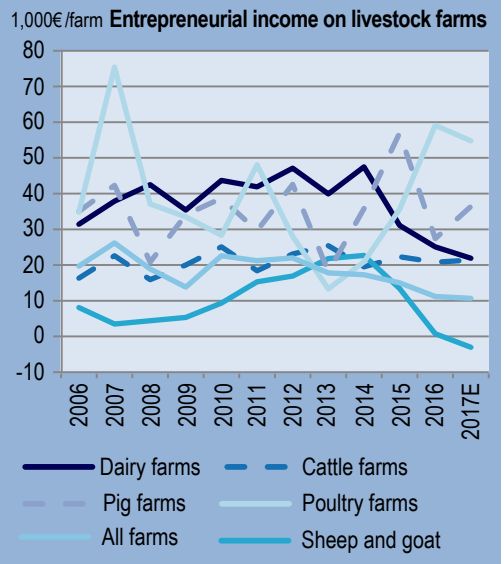
Profitability at a poor level

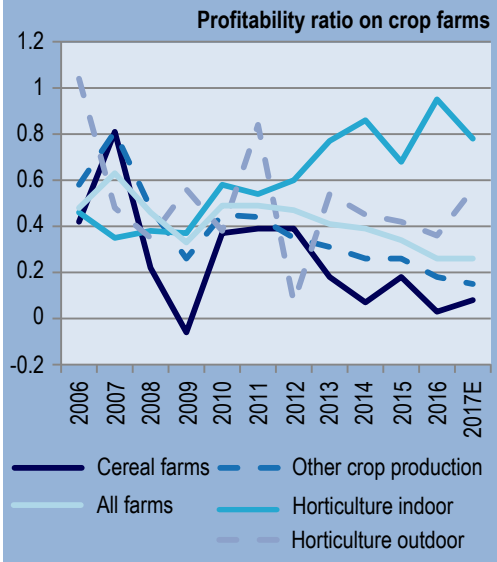
Profitability ratio is considered one of the best key indicators of profitability. It is calculated by dividing entrepreneurial income by the sum of the wage claim of the farming family's own labour and the interest claim on own capital invested in farming. The higher the ratio, the better the compensation achieved for the labour and capital. In 2016, the average profitability ratio was 0.26 and the same level is forecast for 2017. Greenhouse enterprises, poultry farms and farms engaged in outdoor horticulture production were the most profitable, but still, the average profitability ratio of all of them remained below 1. In cereal farms and sheep and goat farms, the ratio was near zero, and in milk farms, it was 0.31. In the past decade, the profitability trend has been on the decrease, following the decrease in entrepreneurial income. In the short term, it is impossible for farmers to adjust their use of labour and capital to match the poorer expected returns.

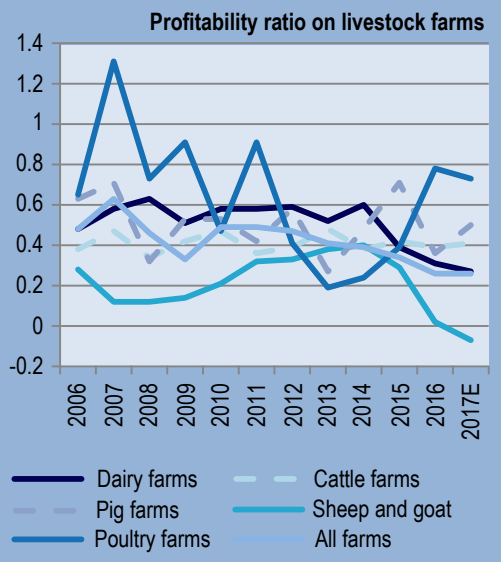
The return on total assets is obtained by deducting all expenses from total revenue, excluding the interest on liabilities (including the wage claim for own labour), and showing the difference in proportion to the entire capital of the farm. It tells the same sad story of poor profitability as the profitability ratio: the return on assets was negative in 2016 (-3.3%), and has not been positive at any time in the past decade. A negative return on assets means that the value of farmers' own capital has decreased in the long term; they have been forced to "eat" their capital.

The picture painted of the development and level of profitability of farms is desolate, as is the forecast for the results for 2017. We should remember, however, that there is also great variation behind the average figures within production lines. For example, the average profitability ratio among the most successful quantile of the dairy and beef farms was bearable, at 0.7–0.9 in 2016. On the most successful cereal farms, it was 0.65, while the figure among the most successful open-air horticulture and poultry farms was over 1. These figures clearly show that it can be possible to achieve at least tolerable profitability levels. Success requires efficient and professional farm management, as well as favourable conditions. It also requires that the development of product and input prices and changes in support systems do not cancel out the efforts made by farmers in order to improve their results.









Entrepreneurial income and profitability ratio of agriculture and horticulture by production line from 2006 to 2016.

4.3. Overall level of agricultural income

The trends in return and cost items, as well as the assets of Finnish agriculture and horticulture in general, are followed at Luke using the total calculation system for agriculture. The overall results are calculated from farm-specific profitability bookkeeping data on agriculture and horticulture by weighting and summing up the results of the bookkeeping farms in the whole country in accordance with the weighting coefficient determined for each farm. The updated results are available in the total calculation online service of Luke's EconomyDoctor website (www.luke.fi/economydoctor/total_calculation).

Trends in the results

In 2016, the gross return of agriculture and horticulture was €5.18 billion, while production costs totalled €6.64 billion. The entrepreneurial profit, obtained as the difference between the gross return and production costs, which indicates absolute profitability, was negative at -€1.44 billion. The entrepreneurial profit in the sector has been negative every year, meaning that income from sales and subsidies has not been enough to cover production costs. When the costs due to the farming family's own labour input and capital are excluded from the total costs, we arrive at the entrepreneurial income remaining for these inputs. In 2016, entrepreneurial income totalled €340 million. In the early 2000s, entrepreneurial income was more than €1 billion. If we account for inflation, current entrepreneurial income is only equal to a third of the income in the early 2000s.

Specification of returns

In the 2000s, the number of farms had fallen from 78,000 to 49,900. Due to growing farm sizes, the returns of agricultural and horticultural enterprises have remained at €5-6 billion throughout this period. Earlier, sales revenues from products fluctuated due to yield variation, but in the past decade, fluctuation has been due to

Economic development of agriculture and horticulture (€ million) and profitability ratio as well as return on total assets from 2006 to 2016.

	Farms represented	Total return	Production cost	Entrepreneurial profit	Entrepreneurial income	Profitability ratio	Return on total assets, %
2016	49,866	5,180	6,640	-1,440	339	0.19	-4.4
2015	50,883	5,710	7,000	-1,290	447	0.26	-3.5
2014	52,950	5,830	7,060	-1,230	558	0.31	-2.9
2013	54,369	6,150	7,380	-1,240	625	0.34	-2.9
2012	56,792	6,150	7,410	-1,270	767	0.38	-2.4
2011	58,001	5,860	7,000	-1,140	828	0.42	-2.1
2010	59,303	5,690	6,930	-1,230	892	0.42	-2.5
2009	61,018	5,410	6,860	-1,450	534	0.27	-4.5
2008	62,540	5,640	6,980	-1,330	645	0.33	-3.6
2007	63,867	5,570	6,580	-1,010	992	0.5	-1.9
2006	66,434	5,040	6,250	-1,210	766	0.39	-4

Source: www.luke.fi/economydoctor/total_calculation

changes in prices.

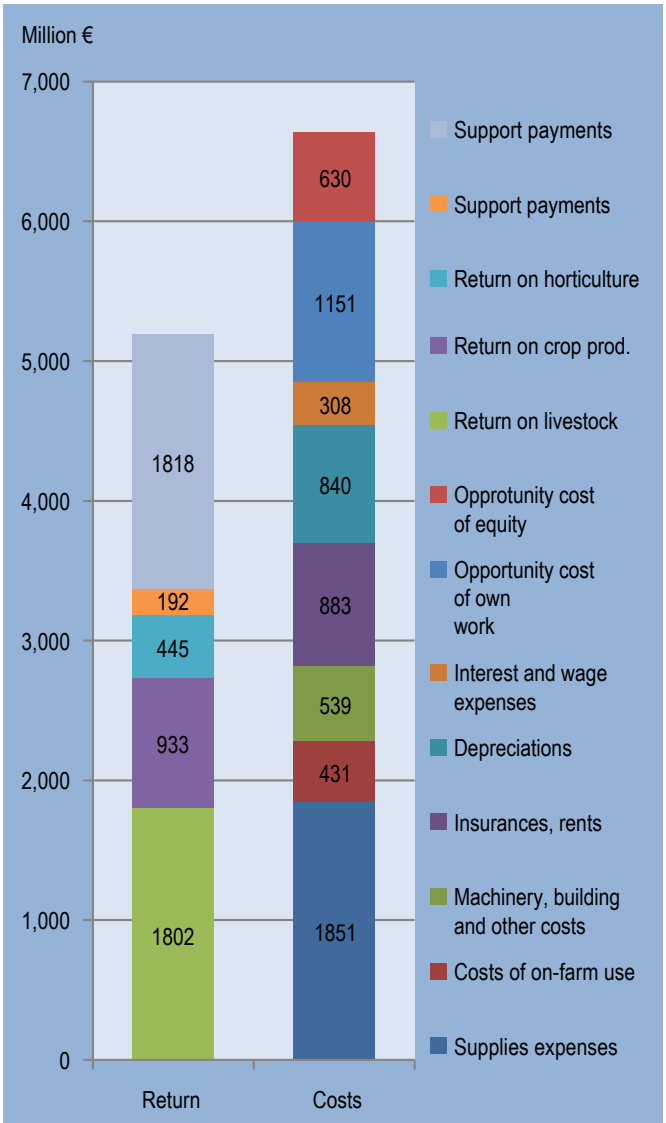
In calculating the results, individual revenue and expense items and support payments are allocated as returns and costs to the year of production, in accordance with the accrual principle. This means that annual variation in yields and returns and changes in prices and support payments are directly reflected in the results. The transfer of sales or support payments to the next accounting year has no impact on the results.

In addition to sales revenues, the returns include the prices of agricultural products delivered outside the agricultural sector or used by the entrepreneur. The returns also include the value of products sold to other sectors and private use, and the value of the feed produced on the farm and used to feed the livestock, which amount to just under €450 million. Support also includes investment subsidies from previous years that are distributed to phases annually in instalments that are equal to the annual depreciation of the assets financed with the investment subsidies.

Of the total returns, crop production has accounted for just under 20%, horticultural production for just under 10%, livestock production for 33% and subsidies around 33%. These shares have remained fairly stable throughout the 2000s.

Specification of costs

In 2016, the production costs of agriculture and horticulture totalled €6.64 billion. Production costs also include the intermediate products listed above as returns. In this way, the use of intermediate products does not increase entrepreneurial income. The wage claim cost resulting from the farming family's own work input fell €500 million in the 2000s, to around €1.15 billion. This is partly due to the transition from livestock production to less labour-intensive plant



Specification of return and costs of agriculture and horticulture 2016.
Source: www.luke.fi/economydoctor/total_calculation

production, and also due to technical developments in production.

The total amount of equity invested by the farming family has increased from under €9 billion in the early 2000s to €13 billion. The amount of equity, calculated per farm, has doubled. The interest expenses accrued from own capital and liabilities has risen from €450 million in the early 2000s to more than €700 million.

Profitability

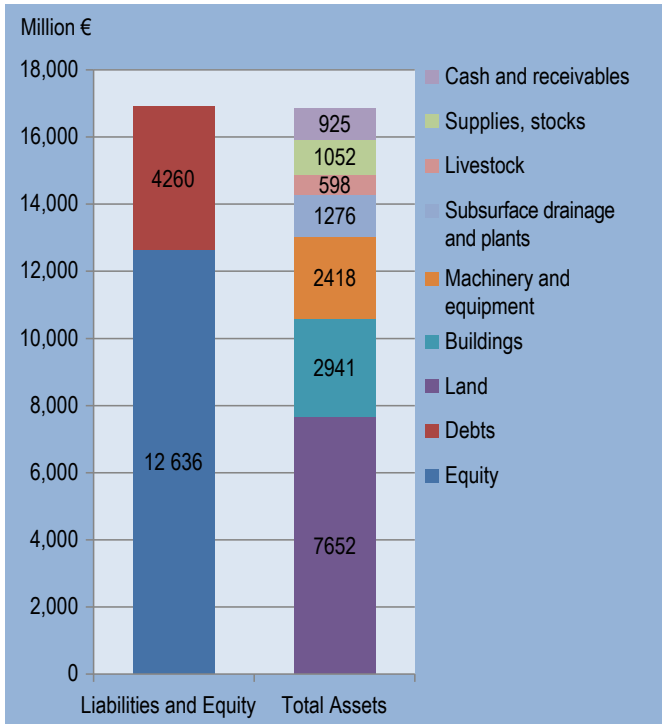
The entrepreneurial income of about €340 million in 2016 covers around 19% of the costs resulting from the farming families' labour and own capital (€1.78 billion), resulting in a profitability ratio of 0.19. In the early 2000s, the profitability ratio was 0.5.

If the total wage claim of €1.15 billion is deducted from the entrepreneurial income of €340 million, the return on the farmers' own capital also turns negative, to the level of -6.4%. It has remained negative, meaning that in order to maintain the current production volume, entrepreneurs require constant external funding.

Solvency

At the end of accounting year 2016, the capital invested in agriculture and horticulture totalled almost €17 billion. Asset items have been measured at current value and include the investment subsidies that have not been entered as income. The depreciation cost of fixed assets purchased using investment subsidies has been calculated, while the subsidies are allocated as returns alongside the corresponding depreciation amounts. Around €12.6 billion of the total assets was the farmers' own capital, bringing the relative proportion of equity from total assets, i.e. the average equity ratio, to 75%. Total liabilities amounted to €4.3 billion at the end of 2016. No debts of the farming families for forestry, other business activities and private household purposes are included in the debts of agriculture. The debt-to-turnover ratio, i.e. relative indebtedness, was 90%. The turnover includes subsidies as well as sales revenues.

The equity ratio has remained very high. In general, agriculture is a capital-intensive sector, and turning capital into income is slow in relation to the cost of interest and payments on external capital. International FADN data shows that a successful agricultural enterprise requires a high equity ratio.



Balance sheet of Finnish Agriculture 2016
Source: www.luke.fi/economydoctor/total_calculation

Great momentum towards the future of horticulture

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Horticultural sector undergoing significant structural changes

During the last 15 years, the structure and business models of the horticulture sector have seen significant changes. The sector has been shaped by various forces of change, both in Finland and abroad. Such forces include changes in the demand for services, new technological solutions and urbanisation. An increasingly international business environment and the blurring of traditional industry boundaries are providing new business opportunities.

The number of businesses in the sector has dwindled in Finland, while the remaining businesses have expanded. According to estimates, this trend will continue. However, overall production – both in open-field and in greenhouses – has remained fairly steady. The industry continues to be dominated by family businesses.

The highest-earning quarter of open-field and greenhouse companies achieves turnovers of nearly EUR 2 million. According to profitability accounting, in 2015, greenhouse companies had an average turnover of EUR 550,000, with the average turnover for open-field companies at around EUR 105,000. Profit margins varied from negative to over 12 per cent.

In order to maintain momentum in the future, it is important to attract enthusiastic new entrepreneurs. Successful entrepreneurs share several key tendencies and characteristics, including the ability to take risks, proactivity and professional pride. Successful entrepreneurs are predominantly able to steer their business operations in a customer-oriented manner without compromising on expertise in quality cultivation.

Increasing demand is boosting business

The demand for vegetables is increasing. Research findings and dietary guidelines are both emphasising the use of plant-based products. Increasing environmental awareness is also boosting the demand for horticultural products, as significant vegetable consumption can help reduce diet-related environmental load.

Furthermore, subsistence farming and greening are gaining popularity, which in turn is reflected positively in the sales of cultivation-related products, such as seeds, seedlings, growing media and ancillary products. In domestic gardens, the values of aesthetics and naturalness are increasing demand for ornamental trees, shrubs and flower seedlings. The status of established brands, such as organic products, is also being reinforced in the horticulture business.

Along with the increase in demand, customer needs are becoming more diverse. The increasing number of small households requires smaller package sizes. Ease of use is another quality that is becoming increasingly popular.

Adopting technology is improving efficiency

The implementation of new technology generally tends to weaken the competitiveness of companies using old technology. The introduction of automation and robotics has made the Netherlands the most efficient flower producer in the world. Robotics

is increasingly replacing human labour in the production of salads, herbs and even tomatoes, which contributes to productivity and profitability. Even a small improvement in energy efficiency can significantly improve the profitability of Finnish greenhouse companies, as energy can represent up to 50 per cent of production costs.

Successful implementation of new information systems enables direct customer contacts between producers and, for example, restaurants, helping reduce production chain costs. New packaging materials and methods help extend product shelf lives and the sales windows for berries and vegetables, for example.

In the near future, technology should enable the manufacturing of food products through industrial processes, such as bioreactors. The possibility of separating food production from soil and location poses a key challenge to the horticulture sector. If plant-based nutrition can be produced in other ways than cultivation, traditionally cultivated horticultural products could become a high added value alternative to novel biomass and cultures.

Urbanisation is a multifaceted force for change

Urbanisation is a global phenomenon that impacts the Finnish horticulture sector as well. The growing global population requires increasing amounts of food and energy. However, there is less and less land available to produce these resources. This is why innovative methods of cultivation are needed.

Creative transformation of urban spaces for professional food production, for example, in the form of shipping container cultivation, and the independence of indoor cultivation from the location and the season, will provide new community-oriented and commercial opportunities.

Significant concentration of urban infrastructure around major cities may impact the operations of traditional horticulture production in sparsely populated rural areas. The availability of skilled labour and transportation will likely become increasingly challenging in remote areas.

The creation of new greenhouse companies in the vicinity of, or within, urban areas will reduce logistics costs. Local farming will increase production transparency and increase the added value of fresh products, because tomatoes and cucumbers picked next door will reach the consumer straight away. Optimally, a production facility integrated into the urban environment may also prove to be a more energy-efficient solution.

New business models are already in use

The horticulture sector is already witnessing new business models. The adoption of innovative business models is typically driven by low profitability of traditional models, or ideas originating outside the sector.

One of the most notable driving forces for change in Finland has been the highly centralised retail trade, which has led the producers to seek alternative sales channels. Short supply chains, such as direct sale and home deliveries, are gaining increasing interest among consumers.

Direct sale also provides the opportunity to sell experiences and services to city dwellers. Furthermore, the products could be further refined, contributing to primary production profitability. For example, a greenhouse restaurant in Närpiö could provide a multitude of culinary experiences in a tropical environment around the year.

Another rising business model is community-supported agriculture, which combines the roles of producer and consumer. In this model, consumers subscribe to a harvest in advance and have the opportunity to influence and participate in the production of the food they personally consume.

Crowdfunding will likely increase in the horticulture industry. The Netherlands has expressed a particular investment appetite for eco-friendly production methods. A customer who has committed to the company will, naturally, expect a return on the capital he or she has invested. This commitment increases the customer's motivation to promote the company on social media, which in turn enhances the company's marketing.

International opportunities

Horticultural products are consumed globally, although in Finland, production is currently mainly aimed at domestic consumption. Rapid technological advancements and demand have opened doors in export markets, particularly for Finnish horticulture technology companies. Finnish agriculture expertise has, through high-level research and technological breakthroughs, reached a level that enables the export of methods and special products at a level above the current status.

With climate change, and in particular the depletion of global water sources, Finnish, sustainably produced horticultural products have increasing opportunities in global markets. The impact of the long day on the flavour of products should be utilised more efficiently. This, however, requires domestic and international collaboration in order to find suitable customer groups, and the right know-how to organising operations.

Blurring of traditional industry boundaries is a major challenge

Utilising the forces for change requires seamless cross-sector collaboration. Developing solutions and marketing products require collaboration between horticulture companies and experts on production technology, logistics and marketing. Already today, every horticultural company has the opportunity to seize the opportunities provided by digitalisation and logistics solutions.

Transformation of a product-based business into service providers requires collaborating with new types of partners. For example, it may be more sensible for a company to lease a green wall and its maintenance from a horticulture specialist, rather than investing in the product separately.

Openness is the key

The horticulture sector has great growth and development potential. It is essential to monitor and identify domestic and international horticulture trends. Observations should be made with an open mind and through open dialogue with partners. Networking with other farmers and operators is vital. Ideas can only be refined through sharing.

The observations and ideas presented in this article are based on the results of the research project "Voimakas: Power to horticulture" funded by Maiju ja Yrjö Rikalan Puutarhasäätiö. The project was aimed at promoting the competitiveness of Finnish horticulture production and analysing new, profitable business opportunities. The final report has been published in Luke's report series and is available (in Finnish) for download at http://urn.fi/URN:ISBN:978-952-326-534-9.

5. Agriculture and the environment

5.1. Environmental impacts of agriculture

Besides food production, agriculture plays an important role in maintaining biodiversity in farming environments and providing landscape and recreational values. In addition to their positive effects, agricultural activities also have negative impacts on soil, waters and the air.

Soil

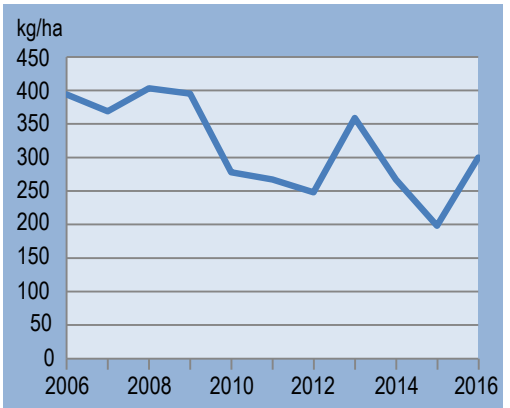
Environmental loading from arable land depends on the soil type, cultivation properties and crop rotations. Finnish soil contains no heavy metals, and its average phosphorus level is satisfactory, but acidity is increasing and the amount of soil organic matter is decreasing.

The phosphorus level in arable land is an indicator of both productive capacity and environmental loading. In Finland, phosphorus levels have been rising until the present time, even with considerable reductions in phosphorus fertilisation since the 1990s through, for example, the fertilisation limits under the agri-environment scheme. At present, the annual increase in phosphorus through purchased fertilisers is less than 6 kg/ha, which is only a quarter of the 1995 level. The annual amount of phosphorus entering the land in animal manure (about 8 kg/ha) is already higher than the amount of phosphorus contained in purchased fertiliser, and no significant reduction has taken place since Finland joined the EU in 1995.

Studies have shown that some further reduction in total phosphorus fertilisation (purchased fertiliser + manure) would be possible without a decrease in yields, except in parcels where the phosphorus levels are particularly low. In the light of current knowledge, turning the phosphorus balance of arable lands into a negative one is the most efficient way of permanently reducing the phosphorus loading of waters. With a negative phosphorus balance, the amount of phosphorus removed from fields through harvesting is greater than the amount of phosphorus entering the land through purchased fertiliser and animal manure.

The load on waters from arable farming is also influenced by the soil structure. Soil compaction in fields reduces the permeability of the soil, which increases the risk of nutrient surface runoff and erosion. It also weakens the nutrient intake of plants, which lowers the nutrient utilisation rate. Poor permeability may also increase the release of greenhouse gases.

Only about 8% of the surface area of Finland comprises arable land. The ownership of arable land is decisive in terms of the long-term productivity of the land. Studies have shown that significantly less land improvement work is being carried out on leased areas than on land owned by the farmer. The use of agricultural lime, for example, has halved from the levels before Finland joined the EU due to the increased share of leased land. In



Quantities of land improvement lime used in 2006-2016
Source: Finnish Food Safety Authority Evira

recent years, the average amount of lime used for land improvement has totalled less than 300 kg/ha/year.

Loading of waters

Nutrients leach into ditches, rivers, lakes and the Baltic Sea from arable land, causing eutrophication. Eutrophication can be seen in the turbidity of the water, increased growth of blue-green algae that is harmful to health, and shores becoming overgrown. Although the volumes of nutrients used per hectare have been significantly reduced, the eutrophication of waters continues, and there has been no significant improvement in the state of surface water compared to the early 2000s.

The Finnish Environment Institute estimated that more than 70% of the phosphorus loading and just under 60% of the nitrogen loading in water bodies is from agricultural sources. In the nutrient loading of the Baltic Sea, Finnish agriculture accounts for around 7% of the nitrogen and phosphorus loading. In the loading of the Archipelago Sea and coastal waters, the share of Finnish agriculture is much greater. The loading of water bodies is caused by both arable farming and livestock production. Because of the regional concentration of livestock production, the amount of manure produced is excessive in many places relative to the agricultural area utilised and the needs of the crops cultivated. The phosphorus contained in manure, in particular, has become a problem.

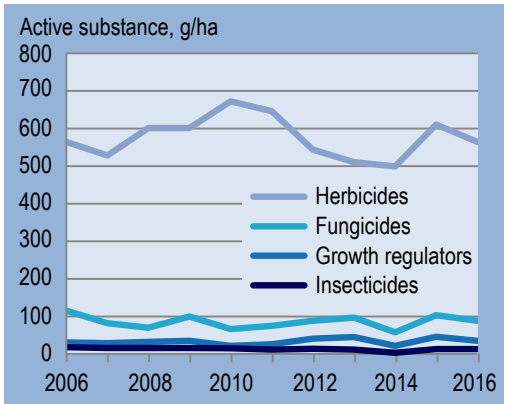
Use of pesticides

The use of pesticides in Finland increased until 2010, since which time their use has declined slightly. 80% of the pesticides used are products intended for weed control (herbicides). Two thirds of these are glyphosate products. The main reason for the previous growth in pesticide use was increased cereal monoculture and the wider use of non-tillage technology. However, on a European scale, the quantities of pesticides used in Finland are still fairly moderate.

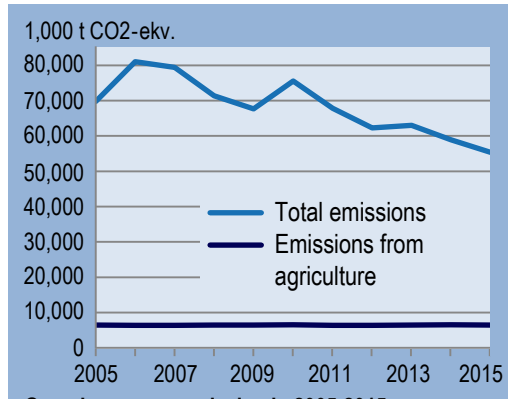
Emissions to the air

Climate change poses new challenges to Finnish agriculture. Measures to adapt to climate change are changing the prioritisation of species and varieties, and the relative profitability of different crops and production methods. Climate change is also influenced by agricultural activities, as agricultural production produces greenhouse gas emissions.

In 2016, greenhouse gas emissions from the agricultural sector represented



Use of pesticides in 2006-2016
Source: Luke



Greenhouse gas emission in 2005-2015
Lähde: Statistics Finland

about 11% of the total emissions in Finland. Most of them are due to the decomposition of organic matter in the soil (nitrous oxide emissions) and digestion of ruminant livestock (methane emissions), but manure processing and the liming of fields also cause emissions.

According to the United Nations Framework Convention on Climate Change (UNFCCC), carbon dioxide emissions from the soil and emissions from the energy consumption of farms are not calculated for the agricultural sector. With the exception of emissions caused by liming, greenhouse gas emissions related to agricultural land are reported in the so-called LULUCF sector (Land Use, Land-Use Change and Forestry). Emissions from the energy consumption of farm buildings, grain drying and agricultural machinery are reported for the energy sector.

Greenhouse gas emissions from the agricultural sector have decreased by 13% since 1990. The primary reason for the decrease is the decline in the use of chemical fertilisers. The most significant decrease in greenhouse gas emissions from the agricultural sector occurred during the early 1990s. There were no significant changes in agricultural emissions in the 2000s.

The agricultural sector is excluded from emissions trading and the objective set for Finnish agriculture is that by 2020, greenhouse gas emissions will be reduced by 13% from the emission levels in 2005. This objective is difficult and expensive to achieve by reducing the use of fertilisers and by adapting the number of ruminants. If the consumption of dairy and meat products remains at the current level, the risk of production and thereby also emissions moving to other countries is high.

According to the 2014 report of the Finnish Climate Panel, the most cost-efficient measures to reduce agricultural greenhouse gas emissions include: diminishing the need to clear organic soil for cultivation, for example, by promoting the solid-liquid separation of manure; long-term fallowing or grass cultivation of organic soil; and reforesting arable lands that have become redundant in regard to production and food security.

In sectors excluded from emissions trading (traffic, agriculture, heating and waste management), obligations to reduce greenhouse gas emissions in the EU are allocated to the Member States using the Effort Sharing regulation. Throughout the EU, the collective target for these sectors for the second period (2021–2030) is set at a 30% reduction on the 2005 emissions level by 2030. According to a proposal published by the Commission in July 2016, the target of Finland's effort sharing sector for the reduction of greenhouse gas emissions is 39% compared to the 2005 level. This target is very challenging to achieve as, for example, there is very limited potential for reducing emissions from the agricultural sector, and the measures of reduction are estimated to be expensive.

Biodiversity in farming environments

Biological diversity comprises the abundance of species, diversity of habitats, and intra-species genetic diversity. The decline in biodiversity is considered to be a serious environmental problem, as biological diversity is the foundation for functioning ecosystems. Without diversity, ecosystems are not capable of adapting to changes in the environment, such as climate change.

Agricultural production is based on the utilisation of biological diversity. Similarly, many wild plant and animal species have, over centuries, adapted to utilising agricultural environments created by man.

The positive impact of agriculture in enhancing biodiversity was at its greatest at the time when animal feed was produced on meadows and natural pastures.

The growth of farm size since the 1950s, together with increased input intensity and farm-specific and regional specialisation, has led to a decline in the biodiversity of farming environments and increased the numbers of threatened species and habitats.

For some wild species that grow in farming environments, changes in their habitats due to new and more efficient production methods have been too massive and rapid, and they have not been able to adapt to the new conditions. In particular, organisms that depend on meadows and forest pastures have declined and become endangered due to the decrease in grazing and cattle husbandry. According to an assessment of threatened habitats, the highest share of these of the total number of habitats of a certain type is found in traditional biotopes, of which 93% are threatened.

However, in habitats maintained by agriculture, numerous wild plant and animal species are still present which benefit from farming activities, open arable areas and grazing livestock, as well as from multiple measures related to the agri-environment scheme and non-productive investments.

Ecosystem services in agriculture

Besides biodiversity, it is also considered important to secure the functioning of ecosystems and the services produced by them. Ecosystem services refer to benefits gained by people from nature. The benefits may be tangible, such as food and raw materials, or intangible, such as recreation. Farmers play a key role in producing ecosystem services in the farming environment.

Ecosystem services are often studied in accordance with the CICES classification (Common International Classification of Ecosystem Services). In the CICES classification, they are divided into three main sections: provisioning services, regulating and supporting services, and cultural services.

People are aware of the provisioning sector, i.e. food and fibre, and their value. Meanwhile, the image of the regulating and supporting services as well as the cultural services is still unclear. The regulating and supporting services and cultural services are often intangible, and many of them can be utilised freely by all. Examples of regulating and supporting services include nitrogen fixation and insect pollination. Cultural services include the recreational use of nature and the cultural heritage related to nature.

Landscape and recreation value of arable environment

The countryside and rural margin areas around towns and cities with arable lands offer important recreational environments for Finnish citizens. Farming environments are important for outdoor recreation, especially in areas with a high proportion of agricultural land. Farming environments are commonly used for local recreation, especially in Southern Finland.

On average, the Finns engage in outdoor activities close to their home 170 times per year, 35% of which take place in farming environments. This means a total of 230 million instances of outdoor recreation per year. Besides local outdoor activities, agricultural areas are also used for recreation involving overnight stays. The average number of nature trips per year is 8, and the average total number of days spent on such trips is 25. Summer cottages and holiday homes are the most popular destinations. About one quarter of nature trips are made to areas of both agricultural and forest activities. Altogether, this means 10 million days a year spent on nature trips in farming environments.

As the aim is to make rural tourism a significant source of livelihood in the countryside, it is important to consider how to develop farming environments into a real

attraction in rural tourism destinations. One way to promote landscape values and access to farming environments for outdoor recreation is through the agri-environment scheme. Studies have shown that the value of agricultural landscape is improved, in particular, by the presence of grazing animals in the landscape and the renovation of farm buildings located on open fields. Both of these landscape features are becoming less and less frequent because of the aim for higher efficiency in agriculture and regional differentiation of production sectors.

5.2. Agri-environmental regulation

In the EU programming period 2014–2020, the baseline for environmental protection in agriculture rests on the cross-compliance conditions, comprising the requirements for good agricultural and environmental standards and the statutory management requirements. From an environmental perspective, the most significant element in the agricultural policy reforms has been the even stronger emphasis on, and recognition of, the link between agricultural support and the environment as an obligation, which is binding on all European farmers.

30% of direct payments by the EU are targeted at greening measures, including conditions on ecological focus areas, crop diversification, and maintenance of permanent grasslands. As a concrete measure, farmers in Uusimaa and Varsinais-Suomi and on the Åland Island must designate 5% of their agricultural area an ecological focus area. Arable farming must be diversified to include two to three crops, depending on farm size. In addition, permanent grasslands must be maintained. Organic production is considered to comply with the greening conditions, which means that it is entitled to the greening payment without the measures listed above.

Agri-environment-climate scheme

The first environmental commitments in line with the programming period 2014–2020 were made in spring 2015. In the scheme, the former model, comprising basic, additional and special measures, was replaced by a parcel-specific system. In the current scheme, the farmer implements follow-up of soil fertility as a farm-specific measure and commits to complying with plant and soil fertility class values set for nitrogen and phosphorus fertilisation.

Besides the above mentioned balanced use of nutrients on the entire farm, there are parcel-specific agri-environment measures concerning plant cover on arable land in winter, enhancing biodiversity in agricultural environments, and the utilisation of manure and recycled nutrients. The measures concerning plant cover on arable land in winter and buffer zones, as well as the measure concerning nature management fields, are targeted on the grounds of water protection, so that in the catchment areas of rivers discharging into the sea, the measures are more demanding and the payment to farmers higher. Specific environmental contracts are concluded on more detailed and site-specific environmental measures to reduce nutrient leaching, increase biodiversity and reduce greenhouse gas emissions.

In 2016, 43,935 farms had made an agri-environmental commitment. An agri-environmental commitment is made by around 86% of those active farmers who applied for the basic payment under direct payments. The commitment area was around 2.06 million hectares, which is more than 90% of the agricultural land of the farmers who applied for the basic payment. No more new agri-environmental commitments can be made during this programming period.

The funding of the Rural Development Programme for Mainland Finland 2014–2020 totals €8.3 billion. The share of the agri-environment-climate measure is €1.6 billion. Around €225 million is planned to be used for the agri-environment-climate scheme every year, which is a little less than in 2007–2013. 42% of the scheme is funded by the EU.

Some of the parcel-specific measures in the agri-environment commitment considerably exceeded the target areas set for the 2014–2020 programming period already in the first year. For example, twice as many buffer zones were established compared to the requirements estimated in the water management plans.

In 2016, in order to secure adequate funding, restrictions were issued in a Government decree regarding certain parcel-specific measures eligible for agri-environmental payments and the right to switch measures. The restrictions are based on the second amendment of the Rural Development Programme for Mainland Finland 2014–2020 approved by the Commission.

As of 2016, the compensation for measures concerning slurry injection or the recycling of nutrients and organic matter is paid for no more than 60% of the farm's eligible arable land. For measures concerning catch crops or renovation plants, the restriction is 25%. It used to be possible to receive support for all eligible arable land. As of 2016, farmers were also no longer able to register new buffer zones. After the end of the 2016 application period for support, new areas concerning perennial environment management grasslands and the management of runoff waters could no longer be registered.

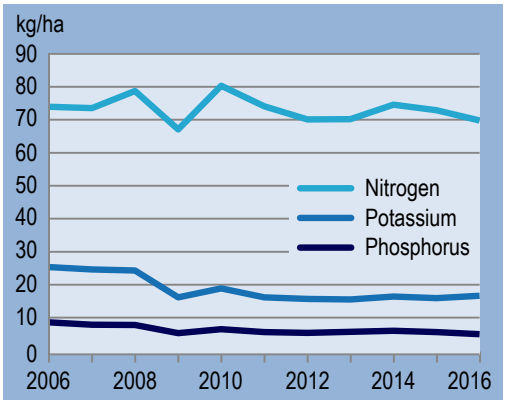
Changes were also made to the calculation of plant cover on arable land in winter. For example, calculations of the plant cover percentage will no longer include buffer zones, perennial environmental management grasslands and nature management field grasslands. At the same time, the new decree allows farmers to give up measures concerning plant cover, if their farm already has the maximum plant cover area in winter, and to switch measures. The decree gives more specific instructions regarding the selection of parcel-specific measures if the farm's special measure contractt has expired.

According to an amendment approved in 2018, for measures concerning renovation plants, payments can be made to farms that engage in crop rotation of potatoes, sugar beets or outdoor horticultural plants for agricultural parcel areas that the farmers have declared in their aid application for the cultivation of one of these plants in 2015, 2016 or 2017.

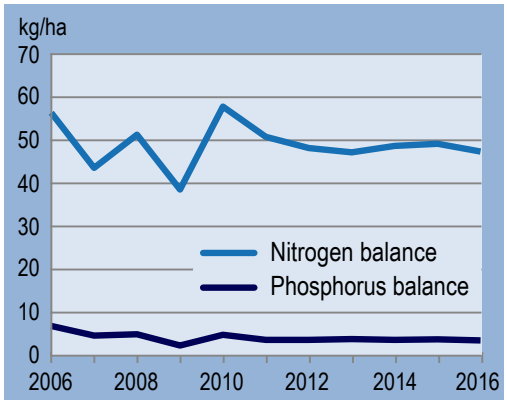
No applications can currently be made for non-productive investments to build a wetland or to initially clear or fence in traditional rural biotopes and natural pastures, as the funds allocated for this are already tied up in ongoing projects. Instead, farmers and registered associations can apply to make agri-environmental contracts to manage wetlands, biodiversity and landscape starting on 1 May 2018. Wetland management contracts are also open to corporations under the water law. In addition to that, contracts are open to those engaged in the maintenance of landrace cultivars and old commercial varieties.

5.3. Guidelines for water protection

Nutrient loading from agriculture involves non-point source loading from over a million agricultural parcels with highly varied characteristics. Besides the physical characteristics, such as slope and soil type, water loading from a specific parcel depends on the weather conditions, and cultivation and tillage practices.



Use of fertilisers in 2006-2016
Source: Luke



Surpluses of nutrient balances in 2006-2016
Source: Luke

The use of nitrogenous fertilisers is regulated by the Nitrates Decree of 2014. The Decree implements the Nitrates Directive and applies to all farmers throughout Finland. The Decree aims to reduce the levels of nitrates from agriculture and horticulture leaching into waters, and ammonia emissions into the air.

In 2007–2017, fertiliser sales per hectare of cultivated land remained the same for nitrogen (around 75 kg/ha), while the figure for phosphorus decreased from 9 kg to 6 kg per hectare of cultivated land. During the same period, the nutrient balances that measure the risk of nutrients leaching into waters have remained almost unchanged. The direction of the trend is right considering both the efforts to reduce nutrient loading and the profitability of agriculture. We should bear in mind, however, that the average per hectare is composed of highly varied fertilisation volumes, which may have much higher loading potential in areas susceptible to erosion. Certain risk areas load the waters much more than average. The phosphorus load caused by particulate and dissolved phosphorus is discussed under a special topic.

In Finland, an estimated 90% of the loading occurs outside the growing season. In this respect, too, the trend is the right one, as the voluntary agri-environment scheme and changes to legislation have increased plant cover in winter, which reduces erosion, and less manure is spread on the lands in the autumn.

In order to enhance water protection and achieve a good status of waters, a number of national and regional programmes and strategies have been launched in Finland. The Government Resolution on Water Protection Policy Outlines to 2015 was passed in 2006. It determined the national objectives for water protection and the measures for achieving a good status of rivers, lakes, coastal waters and groundwater by 2015. Reducing the nutrient loading that causes eutrophication was then set as the key objective. According to the resolution, nutrient loading from agriculture was to be reduced by at least a third from the average in 2001–2005 by the year 2015. The objective was to reduce phosphorus loading by circa 3,000 t/year and nitrogen loading by circa 30,000 t/year.

Finland is divided into eight water management areas, each with a specific water management plan designed in 2009 for the area for 2010–2015. In 2015, the Government approved new water management plans for 2016–2021 for the seven water management areas in mainland Finland.

Some of the water protection objectives still not met

The 2015 ecological assessment of surface waters accords a good or high status to 85% of the surface area of Finnish lakes, and 65% of rivers. Meanwhile, only 25% of the coastal waters have achieved this.

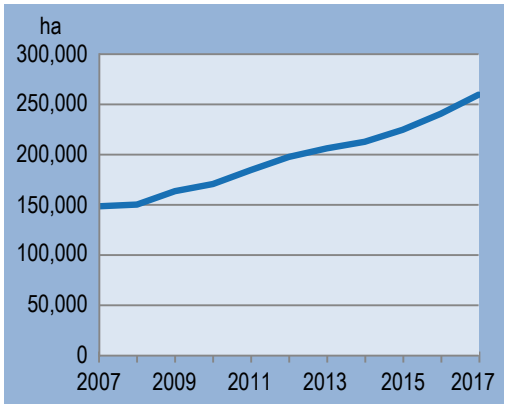
The objectives set in the first water management plans for the reduction in loading were not met. In terms of agriculture, the positive news is that the nutrient balance of cropland has been almost halved since the surplus figures of the 1990s. Despite this, and particularly as regards phosphorus, the soil reacts very slowly to changes in fertilisation. Therefore, even significant reductions in phosphorus fertilisation are not immediately reflected in the loading.

The concentration of livestock production and growing unit size are also a problem as regards meeting the objectives. Transporting manure is costly. Three quarters of manure is handled in liquid form. The method of fertiliser placement is used for more than 40% of liquid manure. Incorporating equipment, such as trailing hoses and devices that cut a furrow into the surface of the field for applying the manure, account for around 30%. Broadcast fertilisation only accounts for less than 30%. Manure is often spread based on the nitrogen requirement of the crop. This means that phosphorus levels become too high for the requirements of the plants and the loading potential increases. A new threat to water quality is climate change, which is expected to increase precipitation, especially outside the growing season.

5.4. Discussion topics and future perspectives

Developing organic production

Organic farming has already gained a strong foothold in Finland. In 2017, organic farming took place or was planned on around 259,450 hectares of fields. This is around 11% of the total cultivation area. However, the market share of organic products is only around 2.5%, which means that the production chain is not working as it should be.



Area under organic cultivation in 2007-2017
Source: Finnish Food Safety Authority Evira

In 2012, the Ministry of Agriculture and Forestry set its own target to increase the share of the organic area to 20% of the total cultivation area by 2020. Efficient organic production and nutrient economy would call for closer interaction between crop and livestock production and better organisation of nutrient cycling than we have at present.

In the Rural Development Programme, a total of €326 million was allocated for supporting organic production in 2014–2020. The support payments to organic farming were increased slightly from the previous programming period.

Greening

Greening measures that are included in the direct payments refer to measures that go beyond the cross-compliance conditions but are more limited than the agri-environment measures. 30% of direct payments are targeted at greening measures. Farms engaged in organic farming or primarily grassland cultivation are granted full or partial exemption from

greening measures. In order to avoid double funding, the coordination of greening measures and the agri-environment climate scheme required clear distinctions in definitions.

In order to be eligible for support payments, farmers must comply with three greening measures:

1) Crop diversification: on farms comprising 10–30 hectares, farmers must cultivate at least two crops, and three crops on farms larger than 30 hectares. Farms north of the 62nd parallel and adjacent areas are an exception; they are required to produce only two crops on farms larger than 10 hectares. The diversification requirement does not apply to farms that cultivate more than 75% grassland if their remaining cultivation area is less than 30 ha.

2) The requirement to maintain permanent grassland: Maintenance of permanent grasslands is monitored at a Member State or regional level.

3) At least 5% of the arable area of the farm to be so-called ecological focus area: In Finland, fallow land, nitrogen-fixing plants, short rotation coppices, and so-called landscape features in accordance with cross-compliance conditions are accepted as ecological focus areas. Exceptions with regard to ecological focus areas have been provided for areas and farms that comply with certain requirements (e.g. predominantly forested areas and grassland-focused farms). In Finland, farms located in Southwest Finland and Uusimaa, or on Åland Island, are required to have ecological focus areas. Farms located outside these regions are exempt from the ecological focus area requirement due to the area being predominantly forested.

The severity of the consequences for failure to comply with the greening measures increases gradually: after a two-year transition period, in addition to losing the greening aid, farmers may also lose a part of their basic payment. Based on preliminary experiences, the implementation of the greening measures is not considered to have been a successful policy.

Permanent grassland

Maintaining permanent grassland is an objective across the entire EU area. The requirement to maintain permanent grassland as of 2015 has applied to permanent grasslands according to the new definition. According to the Direct Payments Regulation (Regulation (EU) No 1307/2013 of the European Parliament and of the Council), permanent grasslands are agricultural lands that are used for cultivating grasses and other herbaceous forage and have not been included in the crop rotation of the farm in at least five years. A land parcel is classified as permanent grassland if it has been grassland continuously for the previous five years and it is also reported as grassland in the sixth cultivation year.

The status of permanent grassland does not impose actual restrictions on use if grass cultivation does not decrease throughout Finland. The status of permanent grassland is year-specific and dependant on the plants cultivated in the land parcel each year. The status of permanent grassland does not mean that the land parcel in question must be used to cultivate grass in the future. If a land parcel with the status of permanent grassland is used to cultivate another plant, the status will be removed.

Parcel-specific grassland measures according to the agri-environment scheme, such as buffer zones, grassland for green manure, nature management field grassland or perennial environment grasslands, will stop the accumulation of permanent grassland. The status of permanent grasslands is monitored on a national level. If the area of permanent grassland decreases in the whole of Finland by 5% of the

reference proportion confirmed in 2015, farmers may be required to return grassland parcels used for a different purpose back to grass cultivation.

Utilising agricultural nutrients

Around 33,000 tonnes of phosphorus fertilisers are used in Finland annually. A little over half of the phosphorus comes from manure and refinery sludge. Around 230,000 tonnes of nitrogen fertilisers are used annually. Around a third comes from manure and refinery sludge. All in all, Finnish agriculture produces around 18 million tonnes of manure annually. The problem is, however, that concentrated livestock production often takes place in different areas from the arable farming that utilises manure. In order for the transportation of manure to be profitable, it has to be processed somehow.

In September 2014, a project was launched to secure the efficient utilisation of agricultural nutrients. The project also launched the section of nutrient recycling included in the national bioeconomy strategy. The aim of the project is to ensure the efficient utilisation of manure and other organic matter containing nutrients produced in Finnish agriculture by 2020. Central measures of the project include agri-environmental payments, training, guidance, investments, and support for enterprises and projects. The project is being carried out in close cooperation with farmers' organisations and other national, regional and local actors. €6.5 million of the Rural Development Programme funds are allocated for supporting enterprises and projects that further nutrient recycling, particularly in the Archipelago Sea river catchment area.

The nutrient recycling pilot programme, part of the spearhead project launched in 2016 by Juha Sipilä's government, brought more than €12 million to the development and testing of innovative technologies and logistics solutions. The pilot programme runs from 2016 to 2018.

Bioeconomy

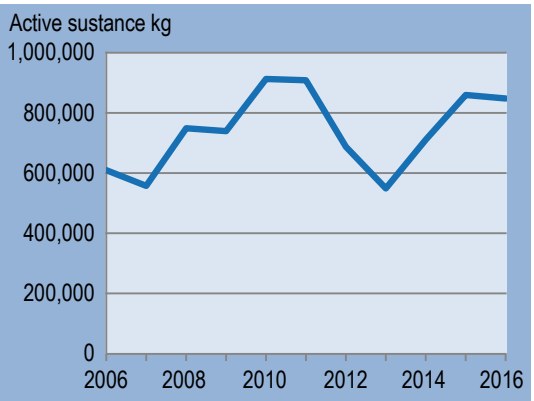
Bioeconomy does not have one specific definition, and different actors highlight different aspects. For some, bioeconomy is about biotechnology, while others emphasise biofuels. Many perceive bioeconomy as the utilisation and processing of biomass, in which case bioeconomy refers to all production that produces, processes, and markets renewable resources, as well to the consumption of products made from renewable resources. This includes the forest industry, the chemical industry, the fishing industry, the agriculture industry, forestry, the food industry, and the pharmaceutical industry. In addition, nature tourism can be classified as part of bioeconomy.

Bioeconomy strives to reduce dependence on fossil fuels and to maintain the diversity of ecosystems. Within the framework of green growth, it promotes economic growth and the creation of new jobs in accordance with the principles of sustainable development.

The Finnish Bioeconomy Strategy was completed in 2014. The objective of the strategy is to generate economic growth and new jobs through the growing bioeconomy business and products and services of high added value, while simultaneously maintaining the functionality of ecosystems in nature. In the initial stage in particular, bioeconomy requires significant investment from society in research, education and infrastructure development.

Glyphosate discussion

The permit to sell products containing glyphosate in the EU was in force until the end of 2017. Glyphosate has been the topic of several discussions recently due



Sales of glyphosate for agricultural and horticultural use in 2006-2016
Source: The Finnish Safety and Chemicals Agency (Tukes)

to its alleged carcinogenic properties. Research institutions studying the negative effects of glyphosate have recommended that the product be classified as a probable human carcinogen. Glyphosate is the most widely used pesticide in the world and banning it would lead to extensive changes in conventional agricultural production. In Finland, the annual sales of glyphosate total around 800,000 kg.

However, the European Chemical Agency (ECHA) has not classified glyphosate as a carcinogen. The European Food Safety Authority (EFSA) has reached the same conclusion and found that glyphosate is not an endocrine-disrupting substance. The re-approval of glyphosate was processed in November 2017 in a Standing Committee meeting. In the meeting, the Commission's proposal to approve glyphosate for five years was not adopted by a qualified majority, meaning that the matter was to be processed by the appeal committee. The appeal committee supported the Commission's proposal and the use of glyphosate was approved for five years until 2022. The Commission's proposal was based on the EFSA risk analysis of the active substance. The use of substances that enhance the effect of glyphosate (POE-tallowamine) in agriculture was previously banned.

Alien species

Alien species are organisms that have spread from their natural distribution range to a new area through human action, whether intentionally or unintentionally. Alien species that have serious negative consequences for indigenous species, ecosystems, crops, agriculture or other sectors are prevented throughout the EU, and are called invasive alien species.

According to the EU Regulation on Invasive Alien Species, all Member States must apply effective management measures in order to eradicate or contain invasive alien species. The Act and Decree on invasive alien species entered into force at the beginning of 2016. Legislation stipulates the responsibilities of landowners and professional actors in preventing invasive alien species and alien species that may cause significant damage particularly in the Finnish conditions. The EU has prepared a list of invasive alien species considered to be of Union concern. Additional invasive alien species of national concern that may cause damage particularly in the Finnish conditions are determined in the Government Decree.

Finland's management plan for preventing invasive alien species of Union concern was passed in March 2018. The plan provides guidelines and methods for preventing 37 alien species, along with a list of bodies required to cooperate in the preventive work.

Mitigating eutrophying phosphorus loading from agriculture

Antti Iho and Risto Uusitalo

Anthropogenic nutrient loading is concentrated in the food chain. At the end of the chain, point source polluters, such as food production facilities or municipal wastewater treatment plants, have been able to improve the efficiency of nutrient abatement. Crop and livestock production operate in open landscape under stochastic weather conditions. There, the flow of water to and from the soil, the release of nutrients from fertilisers and the intake of nutrients by plants cannot be controlled absolutely. Some of the nutrients will inevitably be lost in receiving waters.

For surface water eutrophication, the most problematic nutrient is phosphorus. Our inland waters have generally had limited exposure to phosphorus. Therefore, elevating phosphorus concentration increases algal growth. Phosphorus also contributes to eutrophication in coastal and open sea areas. Eutrophication has numerous symptoms: increased turbidity, changing species composition of fish, mass blooms of blue green algae and anoxic bottom sediments, so called dead zones.

Most of the total phosphorus load from agricultural land is particulate phosphorus attached to eroded soil particles. There are other phosphorus fractions as well, most notable dissolved reactive and non-reactive phosphorus (in this context, "reactive" refers to whether the phosphorus compound produces a colour reaction in a reduced molybdenum solution). The concentrations of these three phosphorus fractions vary between catchment areas (Figure 1). Particulate phosphorus, however, is the most significant fraction in all predominantly agricultural catchments. This is why agricultural water protection measures have traditionally targeted particulate phosphorus load, i.e. erosion.

Permanent vegetative cover is the most important erosion prevention method. In crop production, this is achieved by no-till. However, changes in the total phosphorus load do not provide a clear picture of its impact on eutrophication. In order to determine the eutrophying impact, we should look at the individual phosphorus

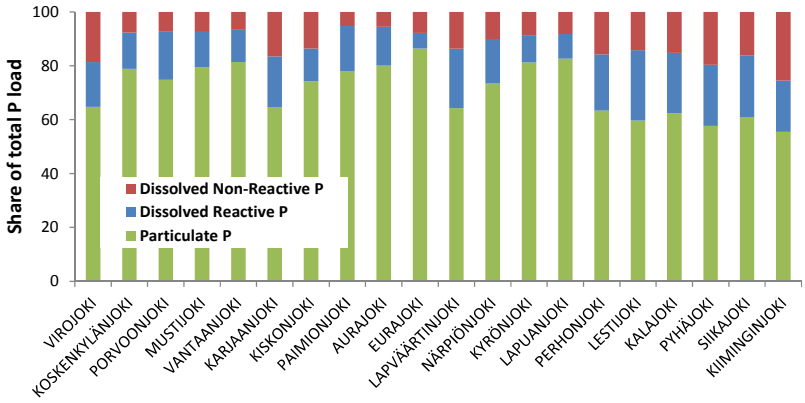


Figure 1. Uusitalo et al. (2014) MYTVAS3 final report.

fractions. Recent research indicates that there are severe trade-offs in particulate and dissolved phosphorus abatement.

Although erosion control measures do reduce the load of particulate phosphorus, this fraction is only partially available to algae. Even in the long run and under anoxic conditions, most of particulate phosphorus remains unavailable for algae. The problem is that the most commonly used erosion control measures (e.g. buffer strips or permanent vegetative cover) increase the leaching of dissolved reactive phosphorus (Dodd and Sharpley 2016). Dissolved phosphorus is completely algal-available. If, for example, 25 per cent of particulate phosphorus were converted into algal-available forms, a unit of dissolved phosphorus would be four times more powerful in accelerating eutrophication. Therefore, algal-availability of particulate phosphorus is of crucial importance in designing efficient water protection.

Managing dissolved phosphorus loading from agriculture is problematic. The potentially plant available phosphorus in soil (approximated by Soil Test Phosphorus; STP), is the key driver of dissolved phosphorus load. STP increases or decreases only gradually, driven by the differences between the amount of fertiliser phosphorus applied and the intake of phosphorus by plants. Soils with excessively high STP levels continue to enrich runoff for decades after the phosphorus fertilisation is balanced with the phosphorus needs of the plants.

Another factor impacting the leaching of dissolved phosphorus is vertical stratification of STP. Under permanent vegetative cover, the STP of soil's top layer gradually increases. This increases the leaching of dissolved phosphorus in surface runoff and drainage flow. The phenomenon is driven by plant nutrient uptake by their roots from deeper layers of soil while the plant residues accumulate and decay on the surface. Luke's field test in Kotkanoja, Jokioinen illustrate this phenomenon. Figure 2 depicts the STP levels for different vertical layers for ploughed and no-till parcels. The field test started in 2007 on a parcel of five-year-old unfertilised grassland which was ploughed in 2008. With the exception of cultivation method, the parcels were treated identically (including fertilisation) until the autumn of 2012.

Phosphorus content in runoff from the different treatments started diverging in 2008, as shown in Figure 3. Meltwater and runoff tend to balance with the soluble phosphorus content of the surface layer. As the phosphorus content of the surface layer increases, the dissolved phosphorus content increases as well. Figure 3 depicts the cumulative phosphorus content in drainage flow and surface runoff, with dis-

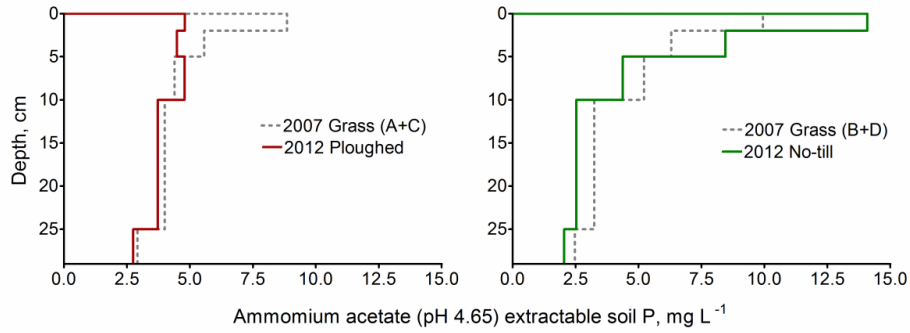


Figure 2. Phosphorus enrichment in the surface layer.

solved phosphorus load on the left and particulate phosphorus load on the right.

The trade-off is clear: particulate phosphorus abatement from no-till comes at the expense of elevated dissolved phosphorus loading. The key question for efficient water protection becomes, then, how much of the particulate phosphorus is eventually transformed into algal-available form in receiving waters. If this were 25 per cent, the no-till parcels at Kotkanoja would contribute more to eutrophying phosphorus load-

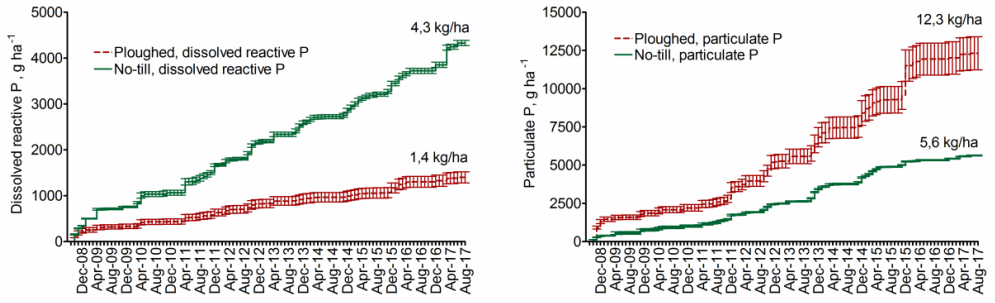


Figure 3. Cumulative particulate and dissolved phosphorus loads at the Kotkanoja test fields.

ing than the ploughed parcels. Only if 45 per cent or more of the particulate phosphorus were converted into algal-available form would the eutrophying load from no-till be smaller than that of the ploughed parcels. Evaluation of the eutrophying potential of particulate phosphorus thus holds the key to efficient water protection in agriculture.

Another factor that impedes water protection is the long memory of receiving waters. The phosphorus content of the water column is typically much higher than the annual load. Furthermore, anoxic sediments can release dissolved phosphorus previously bound in iron minerals in sediments. Despite phosphorus release from bottom sediment may delay recovery of a water body from eutrophication, changes in the eutrophying load originating from surrounding catchment areas will determine the direction of possible changes in the trophic scale. To summarise: there are no quick and simple solutions in eutrophication abatement. Increased pressure to protect the environment must not be addressed with hasty and potentially harmful water protection policies.

Sources

Amis Market Database. Available at http://statistics.amis-outlook.org/data/index.html

Canadian Dairy Information Centre. World Dairy Export Prices. Available at http://aimis-simia-cdic-ccil.agr.gc.ca/rp/index-eng.cfm?action=pR&r=144&pdctc=/.

C.A.P. Monitor. A continuously up-dated information service on the CAP of the EU. Agra Europe.

Chicago Board of Trade (CBOT). Commodity prices. Available at http://futures.tradingcharts.com/marketquotes/index.php3?sectorname=cbot.

CICES Towards a common classification of ecosystem services. 2018. [Internet site]. European Environment Agency. [Referred on 16 Mar 2018]. Available at: https://cices.eu/

Compendium of Laws and Statues. Available at: http://www.finlex.fi/fi/laki/kokoelma/

Confederation of Finnish Industries, EK. Materials. Available at: http://www.ek.fi.

Dodd, R. J., and A. N. Sharpley. 2016. Conservation practice effectiveness and adoption: unintended consequences and implications for sustainable phosphorus management. Nutrient cycling in agroecosystems 104, no. 3: 373-392.

EFSA. European Food Safety Authority. Statistics and reports. Available at: https://europa.eu/european-union/about-eu/agencies/efsa_fi

Eriksson, T., Halla, H., Jokinen, K., Kalliomäki, H., Karhu, S., Koivisto, A., Koponen, A., Mattila, T., Saarimaa, R., Suojala-Ahlfors, T., Särkkä, L. ja Varho, V. 2018. Elinvoimaa puutarhasektorin uudistumiseen ja kasvuun: Voimakas-hankkeen (2015-2017) tulokset, johtopäätökset ja toimenpide-ehdotukset. Luonnonvarakeskus. Luonnonvara- ja biotalouden tutkimus. 5/2018. 33 p. Available at: http://urn.fi/URN:ISBN:978-952-326-534-9

Europe Information. Available at: http://eurooppatiedotus.fi

European Commission 2017. Short term outlook for EU agricultural markets in 2017 and 2018. Available at https://ec.europa.eu/agriculture/sites/agriculture/files/markets-and-prices/short-term-outlook/current_en.pdf.

Eurostat. Your key to European statistics. Available at http://ec.europa.eu/eurostat.

Evira. 2018. Hyönteiset elintarvikkeena. Available at: https://www.evira.fi/elintarvikkeet/valmistus-ja-myynti/elintarvikeryhmat/hyonteiset/

FAO 2017. Food outlook. Biannual report on global food markets, November 2017. Available at http://www.fao.org/3/a-I8080e.pdf.

Finfood - Finnish Food Information. Promoting Finnissh food culture. Available at https://www.ruokatieto.fi/.

Finnish Agency fo Rural Affairs. Mavi. Maaseutuelinkeinohallinnon tietojärjestelmä. www.mavi.fi.

Finnish Customs. Uljas database. Available at www.tulli.fi

Finnish Environment Institute. SYKE. Publications. Available at http://www.syke.fi/fi-FI/Julkaisut.

Finnish Food and Drinks Industries' Federation. Annual Report 2016. Available at: http://www.etl.fi

Finnish Grocery Trade Asociation. Päivittäistavarakauppa 2017. Available at http://www.pty.fi/fileadmin/user_upload/tiedostot/Julkaisut/Vuosijulkaisut/FI_2017_vuosijulkaisu.pdf

Kantar TNS Agri Oy (Earlier name: Gallup Food and Farm Facts). Statistics, market surveys, consumption and production forecasts.

Heiska, S. and Huikuri, N. 2017. Hyönteistuotannon esiselvitys: Hankkeen loppuraportti. Luonnonvara- ja biotalouden tutkimus 76/2017. Luonnonvarakeskus. 144 s. Available at: http://urn.fi/URN:ISBN:978-952-326-502-8

Itämeren fosforikuorma Suomesta. 20 Oct 2016. [Internet site]. Suomen ympäristökeskus. [Referred on 16 Mar 2018]. Available at: http://www.ymparisto.fi/fi-FI/Meri/Mika_on_Itameren_tila/Itameren_fosforikuorma_Suomesta(31444)

Itämeren typpikuorma Suomesta. 20 Oct 2016. [Internet site]. Suomen ympäristökeskus. [Referred on 16 Mar 2018]. Available at: http://www.ymparisto.fi/fi-FI/Meri/Mika_on_Itameren_tila/Itameren_typpikuorma_Suomesta(31457)

Latvala, T., Korhonen, H., Kurppa, S., Naumanen, M., Pesonen, L., Seilonen, I., ja Seppä, H. 2017. Digitalisaatio ruokaketjun kehittämisessä. Valtioneuvoston selvitys- ja tutkimustoiminnan julkaisusarja 60/2017. Valtioneuvoston kanslia, 8.9.2017, 72 p. Available at: http://tietokayttoon.fi/julkaisu?pubid=21403.

Latvala, T. ja Pesonen, L. 2017. Ruokaketjulla voitettavaa digitalisaatiossa. Policy Brief 13/2017. Näkökulmia ajankohtaisiin yhteiskunnallisiin kysymyksiin ja poliittisen päätöksenteon tueksi. Valtioneuvoston selvitys- ja tutkimustoiminta. 7 p. Available at: http://tietokayttoon.fi/julkaisu?pubid=21401

Luke. Natural Resources Institute Finland. Economy doctor. Available at: www.luke.fi/taloustohtori/kokonaislaskenta/.

Luke. Natural Resources Institute Finland, Statistical services. Structure of agricultural and horticultural enterprises, Horticultural Statistics, Farm Register, Milk and Milkproducts Statistics, Nitrogen and phosphorus balance, Number of Livestock, Producer Prices of Agricultural Products, Available at http://stat.luke.fi

National Land Survey of Finland. The market price register of real estates. Available at: http://www.maanmittauslaitos.fi/kauppahintatilastot.

Maaseudun Tulevaisuus -newspaper. Available at: www.maaseuduntulevaisuus.fi.

Ministry of Agriculture and Forestry. Available at: http://www.mmm.fi.

Ministry of the Interior. Available at: http://www.intermin.fi.

Myyrä, S. 2009. Land leasing, land degradation and agricultural productivity in Finland. MTT Science 4. MTT Agrifood Research Finland. [Referred on 16 Mar 2018]. Available at: http://www.mtt.fi/mtttiede/pdf/mtttiede4.pdf

OECD statistics. Available at http://www.oecd.org

Ollikainen, M., Järvelä, M., Peltonen-Sainio, P., Grönroos, J., Lötjönen, S., Kortetmäki, T., Regina, K., Hakala, K. & Palosuo, T. 2014. Ympäristöllisesti ja sosiaalisesti kestävä ilmastopolitiikka maataloudessa. Raportti 1/2014. Suomen ilmastopaneeli. [Referred on 16 Mar 2018]. Available at: http://www.ilmastopaneeli.fi/uploads/kuvat/kuvitus/Ilmastopaneeli_Ympäristöllisesti%20ja%20sosiaalisesti%20kestävä%20ilmastopolitiikka%20maataloudessa.pdf

Prime Minister's Office Finland 2017. Suomalaisen elintarvikeketjun menestyksen avaintekijät. Report. Valtioneuvoston selvitys- ja tutkimustoiminnan julkaisusarja 7/2017. 142 p.

Raunio, A., Schulman, S. & Kontula, T. (toim.). 2008. Suomen luontotyyppien uhanalaisuus – Osa 1 Tulokset ja arvioinnin perusteet. Suomen ympäristö 8/2008. Suomen ympäristökeskus, Helsinki. English abstract: Assessment of threatened habitat types in Finland – Part 1: Results and basis for assessment. [Referred on 16 Mar 2018]. Available at: http://www.ym.fi/download/noname/%7B5E21E78E-3A4E-4C9E-8A4E-05A93CE38F8F%7D/104350

Regina, K., Lehtonen, H., Palosuo, T. & Ahvenjärvi, S. 2014. Maatalouden kasvihuonekaasupäästöt ja niiden vähentäminen. MTT raportti 127. Maa- ja elintarviketalouden tutkimuskeskus, Jokioinen. English abstract: Agricultural greenhouse gas emissions and their mitigation. [Referred on 16 Mar 2018]. Available at: http://www.mtt.fi/mttraportti/pdf/mttraportti127.pdf

Silmusalaatti. 2018. Available at: https://www.silmusalaatti.fi/viljely/

Statistics Finland. National Accounts, Consumer price statistics, Producer price index, The Index of Purchase Prices of Means Agricultural Production, Register of Enterprises and Establishments, Regional Account. Available at: http://www.stat.fi.

Statistics Finland. 2015. Suomen kasvihuonekaasupäästöt 1990–2014. Tilastokeskus, Helsinki: Available at http://tilastokeskus.fi/tup/khkinv/suominir_2015.pdf

Statistics of Kasvistieto Ltd. Helsinki. Available at http://www.kasvistieto.fi/.

Statistics of the Finnish Meteorological Institute. Helsinki. Available at http://ilmatieteenlaitos.fi/.

Statistics of the Glasshouse Growers' Association. Helsinki. Available at http://www.kauppapuutarhaliitto.fi/tietoa-kasvihuonealasta.

Teollisuuden ja yhdyskuntien ravinnepäästöt vähentyneet murto-osaan 1980-luvulta. 23 Nov 2017. [Internet site]. Suomen ympäristökeskus. [Referred on 16 Mar 2018]. Available at: http://www.ymparisto.fi/fi-FI/Kartat_ja_tilastot/Ymparistön_tilan_indikaattorit/Makea_vesi_ja_meri/Teollisuuden_ja_yhdyskuntien_ravinnepaas(28651)

Työ- ja elinkeinoministeriö, maa- ja metsätalousministeriö ja ympäristöministeriö. 2014. Kestävää kasvua biotaloudesta: Suomen biotalousstrategia. [Referred on 16 Mar 2018]. Available at: http://www.biotalous.fi/wp-content/uploads/2015/01/Suomen_biotalousstrategia_2014.pdf

USDA. United States Department of Agriculture. Wheat Data, Feed Grains Database, Soybeans. Available at https://www.ers.usda.gov/data-products/.

Uusitalo, R., Ekholm, P., Lemola, R., Rankinen, K., Sarvi, M., Cano Bernal JE, Ylivainio, K. and Keinänen, H. 2014. Fosforikuormitus ja maan eroosio. In publication: Aakkula, J., Leppänen, J. (toim.) Maatalouden ympäristötuen vaikuttavuuden seurantatutkimus (MYTVAS3) – Loppuraportti. Maa- ja metsätalousministeriö 3/2104, p. 42–52.

Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G., Vantomme, P. 2013. Edible insects. Future prospects for food and feed security. FAO forestry paper 171. 187 s. Available at: http://www.fao.org/publications/card/en/c/7570860e-1517-520f-aa82-3d23672c9cf8

Vesistöjen kuormitus ja luonnon huuhtouma. 4 Sep 2017. [Internet site]. Suomen ympäristökeskus. [Referred on 16 Mar 2018]. Available at: http://www.ymparisto.fi/fi-FI/Kartat_ja_tilastot/Vesistojen_kuormitus_ja_luonnon_huuhtouma

Ympäristöministeriö. 2007. Vesiensuojelun suuntaviivat vuoteen 2015. Valtioneuvoston periaatepäätös. Suomen ympäristö 10/2007. Ympäristöministeriö, Helsinki. English abstract: Finnish Government decision-in-principle on Water Protection Policy Outlines to 2015. [Referred on 16 Mar 2018]. Available at: http://www.ym.fi/download/noname/%7B60A89D2C-7293-4104-831C-8A3E-99A15E5E%7D/30440

Attachments

Number of farms receiving agricultural support according to production line in 2000-2008.									
	2000	2001	2002	2003	2004	2005	2006	2007	2008
Crop farms	38,113	40,578	40,891	41,136	41,263	40,736	41,688	41,488	41,496
Dairy husbandry	22,564	21,026	19,839	18,561	17,427	16,399	15,002	13,732	12,635
Pig husbandry	4,303	3,979	3,807	3,646	3,385	3,149	2,959	2,722	2,477
Beef production	5,206	5,137	4,955	4,818	4,640	4,425	4,244	4,122	4,035
Poultry production	1,220	1,135	1,077	908	1,015	972	928	879	817
Other	6,490	3,510	3,380	3,450	3,355	3,396	3,927	3,878	3,773
Number of farms	77,896	75,365	73,949	72,519	71,085	69,077	68,748	66,821	65,233
Source: Finnish Agency for Rural Affairs.									

Number of farms receiving agricultural support according to production line in 2009-2017.									
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Crop farms	41,195	41,114	40,730	39,609	39,717	38,693	36,607	35,987	35,544
Dairy husbandry	11,807	11,136	10,501	9,827	9,008	8,708	8,223	7,792	7,298
Pig husbandry	2,239	2,036	1,920	1,771	1,539	1,477	1,348	1,250	1,157
Beef production	3,932	3,789	3,745	3,633	3,490	3,469	3,403	3,385	3,355
Poultry production	769	724	696	589	568	563	551	546	531
Other	3,717	3,589	3,504	3,417	3,195	3,073	2,727	2,597	2,521
Number of farms	63,659	62,388	61,096	58,846	57,517	55,983	52,859	51,557	50,406
Source: Finnish Agency for Rural Affairs.									

Number of farms receiving agricultural support according to production line in 2017								
	Southern Finland		Eastern Finland		Middle Finland		Middle Finland	
	Number of farms	%	Number of farms	%	Number of farms	%	Number of farms	%
Crop farms	17,854	78.9	5,223	58.6	8,975	68.8	3,492	59.7
Dairy husbandry	1,744	7.7	2,112	23.7	1,980	15.2	1,462	25.0
Pig husbandry	580	2.6	63	0.7	465	3.6	49	0.8
Beef production	998	4.4	918	10.3	945	7.2	494	8.5
Poultry production	342	1.5	26	0.3	155	1.2	8	0.1
Other	1,101	4.9	564	6.3	516	4.0	340	5.8
Main regions of uusimaa and Åland according to NUTS II have been included in Southern Finland.								
Source: Finnish Agency for Rural Affairs.								

Producer price index and index of purchase prices of means of agricultural production (2010=100).[1]

	Producer price index of agriculture[2]	The index of purchase prices of means agricultural production[3]			
		Total index	Goods and services	Investment	Buildings
2017	129.8*	117.9	113.6	111.4	109.6
2016	113.6	116.2	111.4	110.4	109.3
2015	109.4	114.2	116.1	110.0	109.1
2014	113.6	116.1	119.0	109.1	109.0
2013	129.8	117.9	122.3	107.7	108.1

[1] Indices are based on EU classifications.

[2] Incl. Fur production.

** Preliminary information*

[3] The index of purchase proces - information on this index was decreased in 2015.

From 2015 on the information is only published quarterly.

On the table the predicted index is presented.

Source: Statistics Finland.

Structural change in agriculture

	Number [1] of farms 1,000	Average [1] size of farms, hectares	Number of milk suppliers 1,000	Employed in agriculture[2] 1,000 persons	% of employed
2017	49	47	7	68	2.7
2016	50	46	8	65	2.7
2015	51	45	8	70	2.9
2014	53	43	9	76	3.1
2013	54	42	9	76	3.1
2012	56	39	10	78	3.1
2011	62	37	10	80	3.2
2010	63	37	11	84	3.4
2009	64	36	11	88	3.6
2008	66	35	12	88	3.5
2007	67	34	13	87	3.5
2006	69	33	15	90	3.7
2005	70	33	16	91	3.8
2004	72	32	17	93	3.9
2003	74	31	18	99	4.2
2002	75	30	19	106	4.5
2001	77	29	21	112	4.7
2000	80	28	22	118	5.1
1999	..	..	24	121	5.3
1998	88	25	26	120	5.4
1997	90	24	28	130	6
1996	94	23	30	133	6.3
1995	100	22	32	141	6.7

[1] The compilation of farm statistics was renewed in 2010. According to the new Agricultural and Horticultural Enterprise register, the economic output treshold for a farm enterprise is € 2000. Approximately 4000 farms earlier included in the register now remain below the treshold.

[2] From 2005 based on new industrial classification TOL 2008.

Sources: Luke, Statistical services, Statistics Finland.

Number of animals in May and the average yield per cow.				
	Dairy cows	Yield per cow	Pigs	Hens
	1,000 pcs	litres	1,000 pcs	1,000 pcs
2017	275	8,534	1,129	3,650
2016	282	8,406	1,235	3,599
2015	285	8,323	1,243	3,595
2014	285	8,201	1,245	3,645
2013	283	7,977	1,300	3,432
2012	284	7,876	1,290	3,172
2011	286	7,859	1,335	3,304
2010	289	7,896	1,367	3,394
2009	290	7,850	1,381	2,926
2008	289	7,767	1,483	3,190
2007	296	7,796	1,448	3,134
2006	309	7,646	1,436	3,103
2005	319	7,505	1,401	3,128
2004	324	7,404	1,365	3,069
2003	334	7,251	1,375	3,016
2002	348	7,117	1,315	3,212
2001	355	6,932	1,261	3,202
2000	364	6,786	1,296	3,110
1999	372	6,443	1,351	3,361
1998	383	6,225	1,401	3,802
1997	391	6,183	1,467	4,152
1996	392	5,993	1,395	4,184
1995	399	5,982	1,400	4,179
Source: Luke.				

	Unit	2013 €/unit	2014 €/unit	2015 €/unit	2016 €/unit	2017 €/unit	2018 €/unit
NATIONAL SUPPORT FOR AGRICULTURE AND HORTICULTURE							
NATIONAL AID FOR SOUTHERN FINLAND, NORTHERN AID AND AID FOR CROP PRODUCTION							
AID PER LIVESTOCK UNIT							
Aid for animal husbandry, suckler cows							
AB	€/lu	93	93				
C1	€/lu	300	300	300	300	315	315
C2	€/lu	300	300	300	300	315	315
C2north and archipelago	€/lu	376	376	376	376	391	391
C3	€/lu	451	451	451	451	466	466
C4	€/lu	636	636	636	636	651	651
Aid for animal husbandry, male bovines >6 months							
AB	€/lu	187	187				
C1	€/lu	422	422	422	520	560	560
C2	€/lu	430	430	430	520	560	560
C2north and archipelago	€/lu	506	506	506	620	660	660
C3	€/lu	582	582	582	700	735	735
C4	€/lu	767	767	767	1050	1080	1080
Aid for animal husbandry, ewes and goats							
AB	€/lu	184	184				
C1	€/lu	390	390	363	363	363	363
C2	€/lu	398	398	369	369	369	369
C2north and archipelago	€/lu	474	474	426	426	426	426
C3P1–P2	€/lu	664	664	568	568	568	568
C3P3–P4	€/lu	745	745	629	629	629	629
C4P4	€/lu	956	956	787	787	787	787
C4P5	€/lu	956	956	787	787	787	787
Decoupled aid for pips and poultry							
AB	€/lu	74	76	78	75	68	62
Farms below the farm specific limit[1]							
C1	€/lu	208	208	191	186	181	177
C2	€/lu	182	182	167	163	158	154
C2north and archipelago	€/lu	242	242	223	215	211	208
C3 ja C4	€/lu	251	251	230	222	218	215
Farms over the farm specific limit[1]							
C1	€/lu	105	108	111	107	97	88
C2	€/lu	91	93	96	92	83	76
C2north and archipelago	€/lu	77	79	81	78	71	65
C3 ja C4	€/lu	77	79	81	78	71	65

[1] The farm-specific differentiation of coupled support is applied in northern aid. The farm specific limit for small farms is 146 LU in area C1, 170 LU in area C2, 200 LU in area C2 north and in areas C3 and C4.

	Unit	2013 €/unit	2014 €/unit	2015 €/unit	2016 €/unit	2017 €/unit	2018 €/unit
Northern aid paid for slaughtered animals							
Male bovines C3–C4							
P1–P2	€/slaught. animal	131	131	131	131	131	131
P3–P4	€/slaught. animal	182	182	182	182	182	182
P5	€/slaught. animal	333	333	333	333	333	333
Heifers							
AB	€/lu	240	240				
C1	€/lu	498	498	498	473	500	500
C2	€/lu	498	498	498	473	500	500
C2north and archipelago	€/lu	580	580	580	555	580	605
C3	€/lu	650	650	650	625	650	675
C4	€/lu	793	793	793	768	800	800
Production aid for milk							
AB	cents/l	2.8	2.8				
C1	cents/l	7.7	7.7	7.7	7.9	7.1-7.6	7.3
C2	cents/l	8.4	8.4	8.4	8.7	7.8-8.3	8.0
C2north	cents/l	9.4	9.4	9.4	9.8	8.8-9.3	9.0
C3P1	cents/l	12.4	12.4	12.4	13.1	11.8-12.3	12.0
C3P2	cents/l	14.1	14.1	14.1	15.0	13.5-14.0	13.7
C3P3-P4	cents/l	16.7	16.7	16.7	17.9	16.1-16.6	16.3
C4P4	cents/l	21.4	21.4	21.4	23.1	20.8-21.3	21.0
C4P5	cents/l	30.6	30.6	30.6	33.4	30.0-30.5	30.2
AID FOR CROP PRODUCTION							
Aid per hectare in northern Finland							
C1-area							
Wheat	€/ha	58	58	31			
Rye	€/ha	230	230	154	65	75	75
Starch potatoes	€/ha	204	204	154	100	100	100
Vegetables grown in the open	€/ha	535	535	535	325	350	350
Arable crops, excl. cereals	€/ha	184	184	123	65	75	75
Protein crops	€/ha			69	39	45	45
Sugar beet	€/ha	154	154	154	100	100	100
C2- and C2P-areas, archipelago							
Wheat	€/ha	58	58	31			
Rye	€/ha	230	230	154	65	75	75
Starch potatoes	€/ha	204	204	154	100	100	100
Vegetables grown in the open	€/ha	535	535	535	325	350	350
Arable crops excl. cereals (excl. C2P)	€/ha	73	73	69	65	75	75
Protein crops (excl. C2P)	€/ha			69	39	45	45
Sugar beet	€/ha	154	154	154	100	100	100
C3- and C4-areas							
Vegetables grown in the open	€/ha	535	535	535	325	350	350

	Unit	2013 €/unit	2014 €/unit	2015 €/unit	2016 €/unit	2017 €/unit	2018 €/unit
Aid for special crops in southern Finland							
AB -area							
Starch potatoes	€/ha	100	100				
Vegetables grown in the open	€/ha	100	100				
Aid per hectare of livestock farms							
AB-areas	€/ha	39	41				
General area payment C2–C4							
Cereals and other arable crops							
C2	€/ha	33	28	14		10	10
C2north and archipelago	€/ha	33	28	14	10	20	20
C3	€/ha	49	44	30	20	30	30
C4	€/ha	100	95	70	50	55	55
General area payment for young farmers C1–C4	€/ha	36	36	36	36	40	40
National aid for sugar beet	€/ha	350	350	350	350	350	350
Aid for greenhouse products AB							
over 7 months	€/m2	10.3	10.5	9.7	9.6	9.4	8.9
2–7 months	€/m2	3.8	4	3.7	3.6	3.4	3.0
Aid for greenhouse products C1 –C4							
over 7 month	€/m2	10.6	10.6	10.0	9.7	9.5	9.1
2–7 months	€/m2	4.1	4.1	4.0	3.7	3.5	3.1
Storage aid for horticulture products							
AB-area							
Storages with thermo-control system	€/m3	14.2	14.2	14.2	14.2	10.0	10.0
Other storages	€/m3	8.8	8.8	8.8	8.8	6.2	6.2
C-areas							
Storages with thermo-control system	€/m3	14.2	14.2	14.2	14.2	14.2	14.2
Other storages	€/m3	8.8	8.8	8.8	8.8	8.8	8.8
Conversion coefficient of livestock units in national aids							
Livestock unit							
Suckler cows	1						
Suckler cow heifers. over 2 years	1						
Suckler cow heifers. 8 months–2 years	0.6						
Bulls and steers. over 2 years	1						
Bulls and steers. 6 months–2 years	0.6						
Ewes	0.15						
She-goats	0.48						
Horses							
- breeding mares (horses and ponies)	1						
- Finnhorses. at least 1 year a	0.85						
- other horses 1–3 years	0.6						

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