Chapter 2

Overview of the food and agriculture situation in Estonia

This chapter describes the overall economic, social and environmental context in which the food and agriculture sector in Estonia operates, and the natural resource base upon which it relies. It provides an overview of the general geographical and economic characteristics of Estonia; outlines the share of the agri-food complex in the economy; identifies the main structural characteristics of the food and agriculture sector; provides an overview of the main food and agriculture outputs and markets; and analyses the main trends in agricultural productivity, competitiveness and sustainability.

2.1. Overview and challenges

Estonia is a Baltic country, with a favourable environment for investment, but a small domestic market (Chapters 3 and 4). Characterised by abundant land and water resources, Estonia's agricultural sector is dominated by milk production, but cereals and oilseeds production has increased considerably in the last decade. Meat production has also increased over the last two decades, though production levels have declined in the last couple of years in response to lower market prices and the outbreak of African Swine Fever (ASF).

Agricultural policy and regulatory changes linked to land restitution during the transition period starting in 1990, and EU accession in 2004, in particular the implementation of the Common Agricultural Policy (CAP), have significantly impacted the sector. Following a contraction during the transition in the 1990s, the sector expanded and grew in the 2000s in part due to the creation of agricultural land registers securing property rights. Since acceding to the European Union, agricultural land that was abandoned during the transition was also reclaimed to qualify for CAP financing (see Chapter 6 on conditions for receiving CAP support).

The sector is characterised predominantly by arable land, including cultivated grassland. Since the introduction of the EU single area payment scheme (SAPS), the area of agricultural land not used for agricultural production but maintained in good agricultural and environmental conditions (GAEC) has increased. As permanent grassland, this area is under extensive and biodiversity-friendly agricultural land use, and these areas account together for one-third of Estonian agricultural land. Moreover, Estonia's area for organic production has grown significantly due to EU support over the last decade, and part of organically-farmed land can be considered as under biodiversity-friendly practices.

The agricultural sector has a dualistic structure — with large technically-efficient, more input intensive and innovative farms, next to very small farms. This divergence can be seen both in terms of the distribution of utilised agricultural area (UAA) as well as livestock production. Estonia's food processing sector is also dualistic, and struggling in terms of capacity and competitiveness. The small domestic market is also a challenge for food processing in Estonia.

While Estonian exports are growing, the country has a large trade deficit of agricultural and food products due to high imports of processed foods. The composition of Estonia's agro-food trade suggests the food manufacturing industry is not as developed as primary production. Estonia's imports of agro-food products are mainly for household consumption, while the country exports a large share of agro-food products for industrial use. For example, Estonia is a net exporter of cereals, but a net importer of processed cereals, and a net exporter of live animals, but a net importer of meat.

Agricultural total factor productivity (TFP) has been growing rapidly since 2000. This reflects strong increases in agricultural production, with more efficient input use facilitated by economies of scale, investment in modern, labour-saving, technologies, and seed and animal genetic improvements, for example. While agricultural labour has declined steadily since 1990, labour productivity remains much lower than in EU15 countries from the North of Europe, as is the case in the food processing industry (Figure 2.15). Productivity progress is unequal across farms, with the largest operations driving sectoral performance. Thus, farm consolidation, in particular the exit of most inefficient farms, has contributed to sectoral productivity growth.

Paralleling the growth in agricultural TFP and production, the use of natural resources has similarly shifted. In particular, agricultural land area increased, but at a slower rate than production volume and TFP growth. At the same time, Estonia's direct on-farm energy consumption and ammonia emissions also increased, raising concerns about sustainability. Moreover, eutrophication due to nutrient loads from diffuse and point sources threatens sustainable management of agricultural and water resources in certain regions. The country's phosphorus deficit has also worsened. On the other hand, higher TFP and output growth in recent years has been achieved with improvements in Estonia's nitrogen balance and lower water use, a positive trend in sustainability terms.

Looking forward, climate change projections suggest that both grasslands and crop production may benefit from shifts in climatic conditions in the coming decades. The growing season has already begun to lengthen in recent decades, favouring the cultivation of winter crops. However, potential risk factors include an increase in the frequency of extreme meteorological phenomena (droughts, excessive moisture, flooding) and the spread of plant diseases, plant pests and infectious animal diseases.

The sustained production and productivity growth since 2000 reflects the catching up of the sector following the transition and uncertainties of the 1990s, stimulated by EU investment support. This has facilitated farm modernisation and upgrading of technology, in particular in dairy farms (Box 2.3) and crop farms (Box 2.4). Further efforts remain, however, to improve the productivity of smaller-scale operations, including through wider diffusion of innovation and integration in the innovation system.

Maintaining the recent agricultural growth rates sustainably will require further innovation, but more careful investment, improvements along the food chain, the development of new markets and increased consideration of sustainability issues and consumer demand, as well as longer-term challenges and opportunities.

2.2. General geographic and economic context

The Republic of Estonia, situated on the coast of the Baltic Sea, is the northernmost of the Baltic countries, and the smallest in terms of surface area. The Estonian territory comprises 45 339 km^2, of which the land surface area is 43 432 km^2. Estonia stretches 350 km from East to West and 240 km from North to South. Tallinn, the capital, is situated in Northern Estonia.

Estonia's **land and water resources** are abundant: 22% of the territory is UAA, 7% is comprised of settlements, roads and pipe-laying routes, and the rest of the territory is covered with forests (50%), marshes, bogs and shrubs. In 2013, the country had 13 million m^3 of freshwater resources. This amounts to nearly 10 000 m^3 per capita (two times higher than the EU28 average and about 20% higher than the OECD average) (Land Board, 2015; Statistics Estonia, 2016; AB, 2016; WBG, 2015).

Lying east of the Baltic Sea, Estonia's **climate** is typical for its location in the temperate zone in the Atlantic continental region. Characteristic of the boreal biogeographical region, summers are moderately warm and winters are moderately cold (the mean air temperature in July being 16-17°C and in February between -3 and -7°C). In the second half of the 20th century (especially from 1966-2010), the air temperature has risen faster than the global average. Moreover, the climate is extremely damp as annual precipitation exceeds evaporation by approximately two times.

Estonia is the smallest Baltic country in terms of **population and area**, and is relatively urban. In 2016, the population of Estonia was 1.3 million and the population density was 30 inhabitants per km^2 of land. The Estonian population decreased regularly over the period 1991-2014, as both natural increase and net migration were negative. In 2015 and 2016, net migration was slightly positive, but it is too early to say that the trend has been reversed. In 2015, nearly two-thirds of the population lived in towns and cities and just over one-third lived in rural areas. The urban-rural distribution has remained relatively constant over the past three decades.

The Estonian **economy** has grown faster than the OECD average since 2000, although it was adversely affected by the global economic crisis (Chapter 3). Economic growth in the early 2000s was driven by deepening integration with international supply chains, EU structural funds after accession in 2004, foreign direct investments and loans, fast growth in the construction and real estate sectors and the accompanying credit boom. During the global economic crisis, however, unemployment increased and internal demand was hampered by declines in investment and private consumption. However, unemployment rates were slightly above the OECD average in 2016, but below the Eurozone rate (OECD, 2016a). In 2016, GDP per capita in Estonia was 30% below the OECD average (OECD, 2017a).

2.3. The role of agriculture in the Estonian economy

The agricultural sector's contribution to Estonia's **value added** declined over the last two decades, but it rebounded to some degree in the last few years and is slightly higher than in many Northern European countries. Falling from 4.8% to 2.4% during the 2000s, the share of agriculture, hunting, forestry and fishing in Estonia's total value added increased to a peak of 3.9% in 2011 to fall again to 3.4% in 2015 and 2.9% in 2016. This share remains higher than the average of EU and OECD countries, including neighbouring EU member states except Latvia (Figure 2.1).

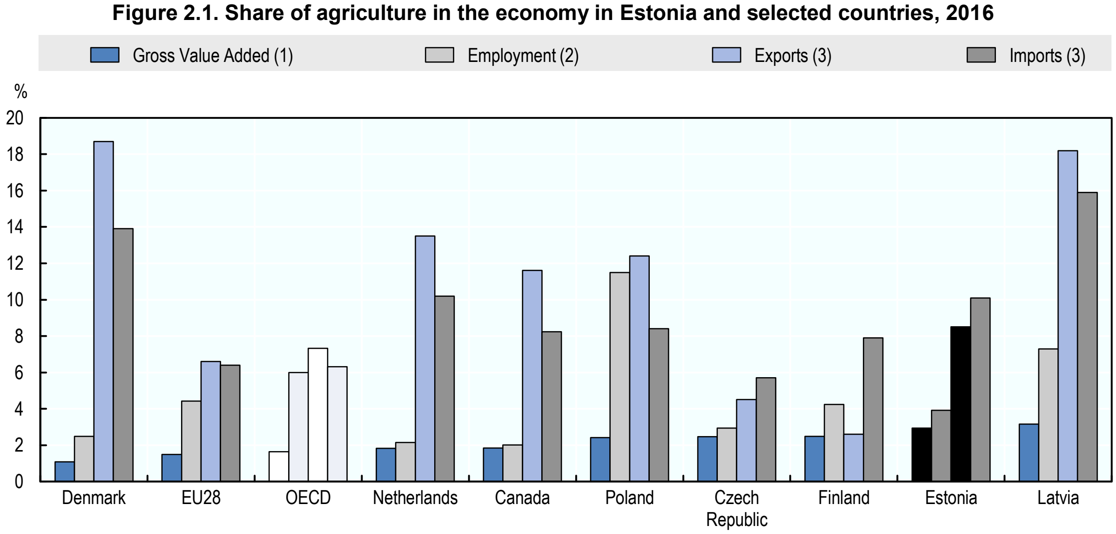
Employment in the Estonian agricultural sector declined faster than value-added. While 10% of the labour force was in agriculture, forestry and fishing in 1995, this share fell to 3.9% in 2015 (Figure 2.1). The share of employment in OECD countries and EU28 were only slightly higher (6% and 4.4%, respectively in 2015).

The agricultural sector is an important contributor to **trade**, though its share declined during the transition and only rebounded slightly after EU accession. As illustrated in Figure 2.1, the share of agriculture in trade in Estonia was lower compared to Denmark, Latvia and the Netherlands, but higher than the EU and OECD averages.

In terms of **natural resources**, the Estonian agricultural sector relies on a large share of land resources, but has a low share in water withdrawal (Figure 2.2). Agriculture uses less than a quarter of Estonian land, while its share in water withdrawal is the lowest among selected countries — less than 1% in 2012-15. The area of irrigated agricultural land is very small in Estonia (0.04% of agricultural land) due to the damp climate, and drainage is important.

In comparison to other Central and Eastern European countries, the intensity of agriculture is lower and the state of agro-ecosystem conditions ranges from good to favourable in Estonia (see final sections). However, certain regions in Estonia have been identified that need further attention in order to manage agricultural and water resources in a sustainable manner — in particular, the Nitrate Vulnerable Zone in Central and North-Eastern Estonia.

Figure 2.1. Share of agriculture in the economy in Estonia and selected countries, 2016

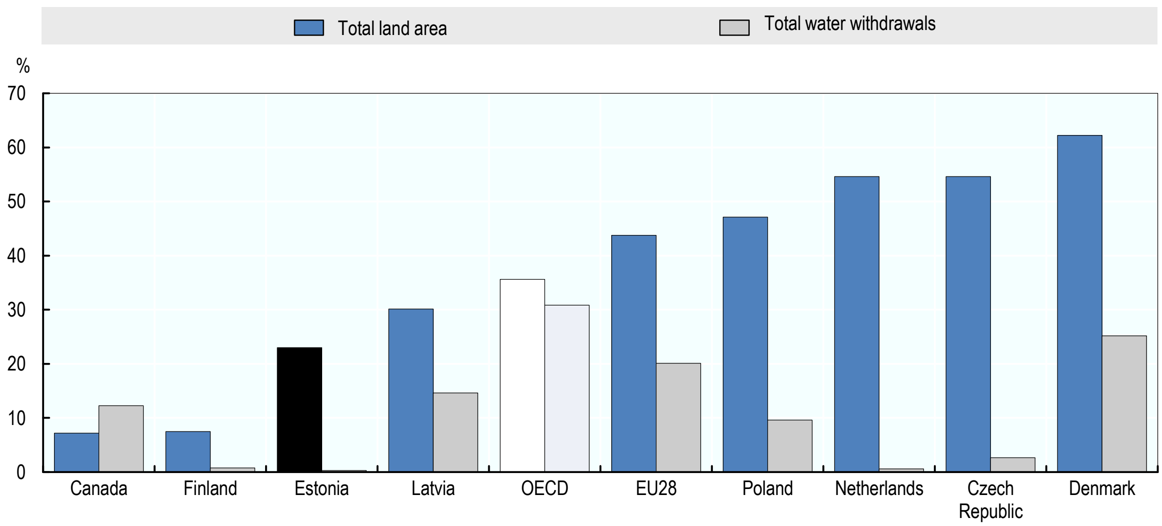


Countries are ranked according to Gross Value Added levels.
1. Value added in agriculture, hunting, forestry and fishing as a percentage of total value added.
2. Share of employed persons aged 15 years and over, in agriculture, hunting and forestry in total NACE activities. Employment data are for 2015.
3. Agro-food definition does not include fish and fish products. Agro-food codes in H0: 01, 02, 04 to 24, 3301, 3501 to 3505, 4101 to 4103, 4301, 5001 to 5003, 5101 to 5103, 5201 to 5203, 5301, 5302, 290543/44, 380910, 382360.

Source: OECD (2016b), System of National Accounts, OECD Annual Labour Force Statistics, http://data.oecd.org/; UN (2016), COMTRADE, https://comtrade.un.org/.

StatLink http://dx.doi.org/10.1787/888933653686

Figure 2.2. Share of agriculture in natural resources in Estonia and the selected countries, 2015[1]



Countries are ranked according to shares of total land area.

1. 2015 or the most recent available year.

Source: FAOSTAT (2016), www.fao.org/faostat/en/; FAO (2016), AQUASTAT, www.fao.org/nr/water/aquastat/main/index.stm.

StatLink http://dx.doi.org/10.1787/888933653705

2.4. Structural characteristics of farms, and upstream and downstream industries

Land use

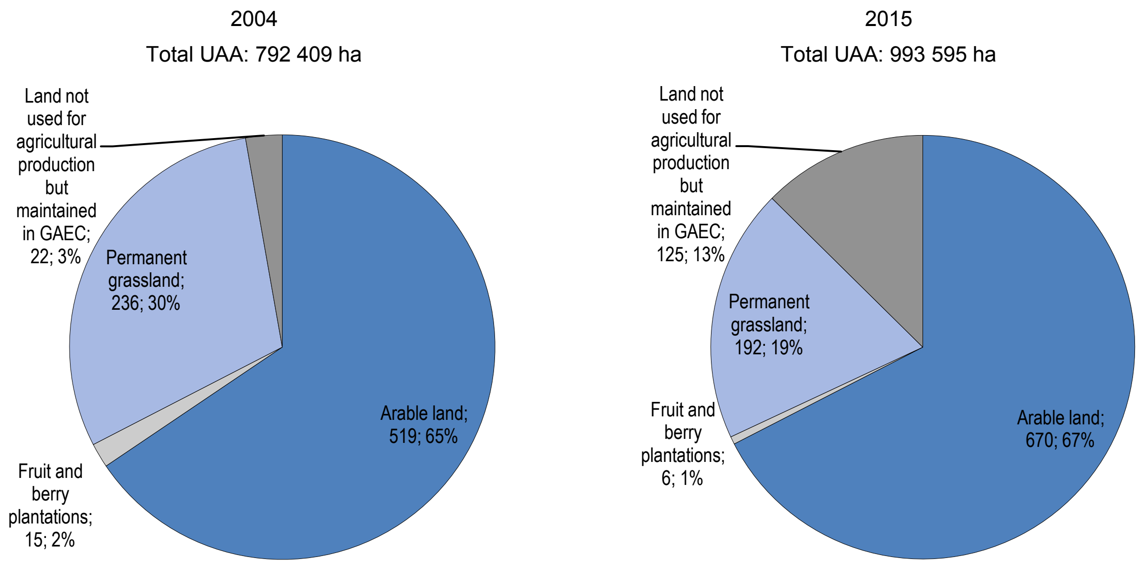
Estonia's **UAA** has fluctuated in recent decades, primarily due to policy shifts. During the transition period, UAA levels fell by half from about 1.4 million ha in 1993 to about 0.7 million ha in 2002. UAA then started to increase to reach 1 million ha in 2015. This is partly due to land declarations on agricultural land registers securing property rights (Seeder, 2013). In addition, after accession to the European Union, agricultural land that was abandoned during the transition period was reclaimed to qualify for CAP single area payments as agricultural land maintained in GAEC qualifies for this payment whether under production or not.

Arable land accounts for more than two-thirds of **agricultural land** in Estonia, with arable area and UAA increasing by 29% and 25% respectively over the period 2004-15 (Figure 2.3). The area of agricultural land not used for agricultural production but maintained in GAEC increased as well — its share in UAA reaching 13% in 2015, compared to 3% in 2004. Meanwhile, the share of permanent grassland in total UAA has decreased by 11 percentage points, reflecting the transition to land not used for agricultural production maintained in GAEC, and the increase in UAA (Figure 2.3).

Driven by support to organic farming, Estonia's land area under organic production has significantly increased since 2004 (Box 2.1).

Figure 2.3. Utilised agricultural area in Estonia, 2004 and 2015

1 000 ha and percentage of total utilised agricultural area (UAA)



GAEC: good agricultural and environmental conditions.

Source: Statistics Estonia (2017), www.stat.ee.

StatLink http://dx.doi.org/10.1787/888933653724

Box 2.1. Organic farming in Estonia

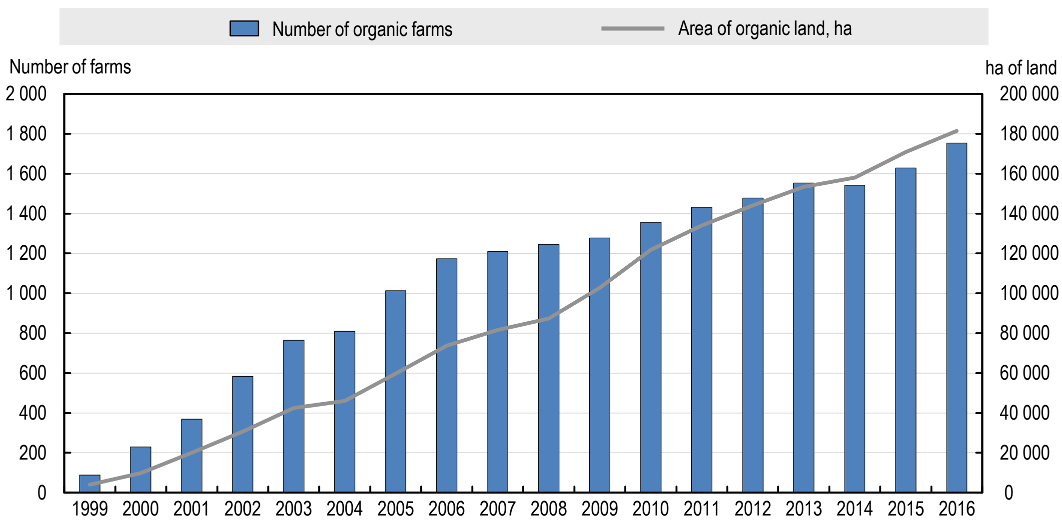
Estonia's land area under organic production almost quadrupled from 46 000 ha in 2004 to 181 500 ha in 2016 (Figure 2.4). The average size of organic farms has also increased — from 57 ha in 2004 to 104 ha in 2016. During the same period, the number of farm enterprises engaged in organic production increased from 810 to 1 753. Organic land use in Estonia is characterised by a large share of grasslands (77% of organic agricultural land in 2015). In 2012, approximately two-thirds of organic farmers were engaged in organic livestock production (MoA, 2015). Recent years have witnessed a rise in organic processing and marketing. As of June 2017, there were 345 processors, packers, distributors and storers in the Organic Farming Register, which was 125 more than in 2014 (MRA, 2016d; AB, 2017).

Land under organic production constituted 17% of UAA in 2015. While the land productivity of organic farming has improved since 2010, yields for both crop and animal production remain lower among organic producers than those of conventional agriculture. For instance, average crop yields of organic wheat and conventional wheat in 2015 amounted to 1.7 and 4.2 tonnes per ha, respectively. During the same period, the average annual milk yields per cow in organic and conventional holdings were 6 464 and 8 266 kg (FADN, 2017a). If the share of organic production continues to increase, it will be important to increase organic productivity growth to sustain and increase further total agricultural output. At the same time, organic production has a positive impact on biodiversity indicators (such as the diversity and species composition of vascular plants in the fields and field margins; bumblebee indicators; and the diversity and abundance of nesting birds). Future efforts to promote productivity growth on organic farms will need to achieve a fine balance with environmental constraints.

The yield gap between organic and conventional production may decrease if farms in more productive areas were to adopt organic practices. The majority of organic farms in Estonia are located in regions with traditionally extensive agriculture as a result of less favourable natural conditions (Kimura and Le Thi, 2013). In 2015, the highest number of organic farms was in Võru (196) and Saare (178) counties. The largest amount of organic land was in Saare (19 251 ha) and Lääne (18 781 ha) counties — collectively comprising more than 30% of organic agricultural land. These counties are often characterised by small fields; low nutrient content and stony soils with sandy and clay texture; and a high share of semi-natural habitats on waterfront pastures and other areas with excessive moisture (MRA, 2016d; Statistics Estonia, 2017).

Box 2.1. Organic farming in Estonia (cont.)

Figure 2.4. Developments in organic farming, 1999 to 2016



Source: EEA (2014a), MRA (2016d).

StatLink http://dx.doi.org/10.1787/888933653743

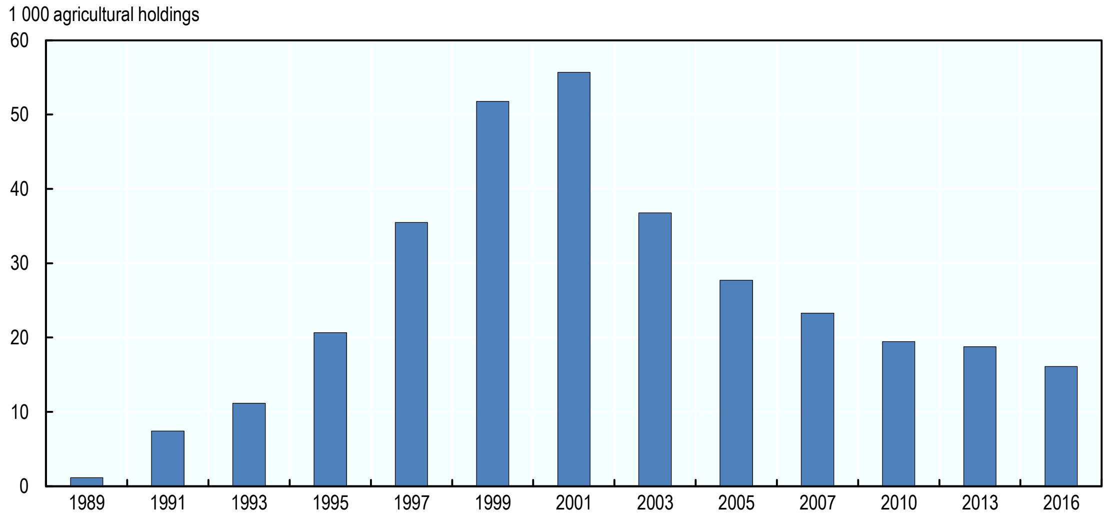
Farm structures

The **number of farms** in Estonia has fluctuated in recent decades, increasing in the 1990s due to privatisation and restitution and then decreasing in the 2000s due to consolidation and farm exit. After restoring independence, agricultural ownership and land reforms were initiated, collective and state farms were privatised, and farmsteads were restituted to the pre-war owners or their heirs. This led to a significant increase in the number of agricultural holdings — from 1 154 in 1989 to 55 748 in 2001 (Figure 2.5) (Viira et al., 2009). However, the number of farms declined in the 2000s (to 16 079 in 2016), as many of the farms established in the 1990s on reclaimed land did not prove viable (due to insufficient skills or investment). Moreover, some farms were consolidated.

Farm consolidation in the 2000s has led to an increase in average **farm size** and in the number of larger farms. The number of farms with more than 50 ha has increased substantially between 2001 and 2016, while all categories of smaller farms decreased.

Between 2000 and 2010, the mid-point farm size in crop farms[1] increased from 72 ha to 276 ha, which is higher than in France and England, but lower than in Germany and Latvia, where it reaches 472 ha (Figure 2.6.A). During the same period, the mid-point farm size of dairy farms[2] also increased from 262 to 363 Livestock Unit (LU), which is particularly high by EU standards (Figure 2.6.B).

Figure 2.5. Number of farms in Estonia, 1989 to 2016

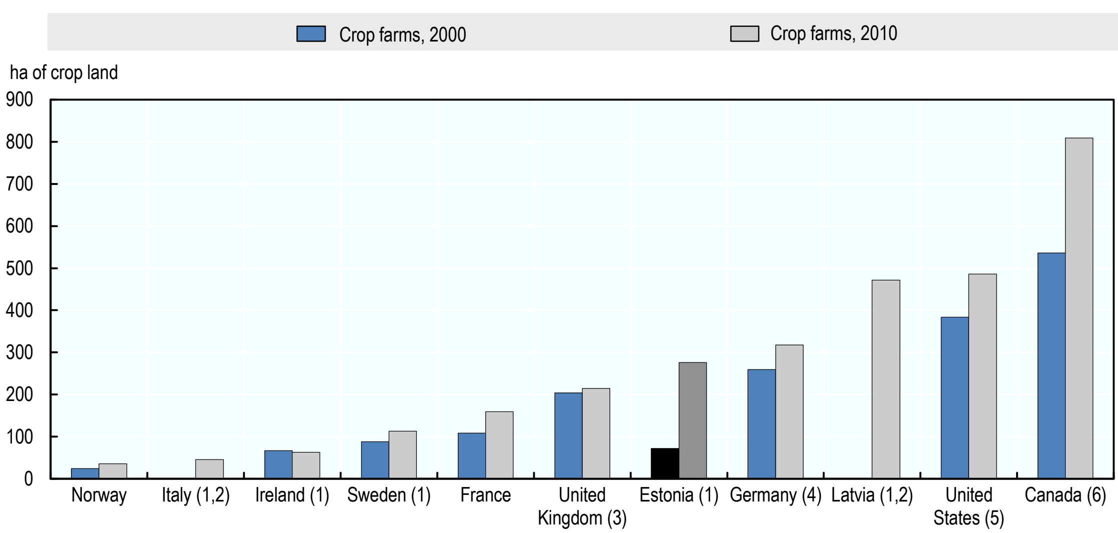


Source: Statistics Estonia (2017), [AGS406], www.stat.ee.

StatLink http://dx.doi.org/10.1787/888933653762

Figure 2.6. Developments in mid-point farm size, 2000 and 2010

A. Crop farms

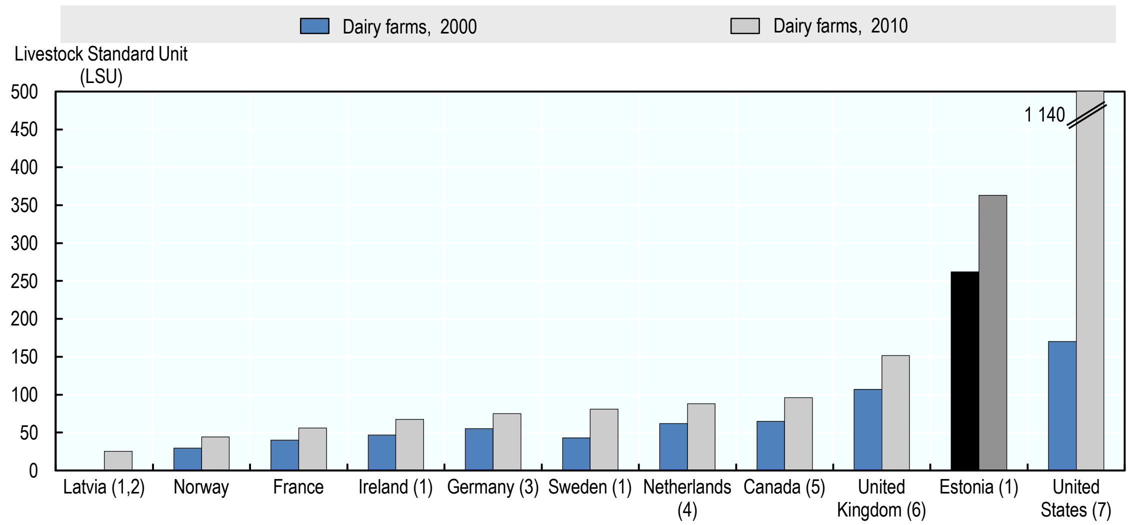


Countries are ranked according to 2010 levels.

The mid-point farm size applied to crop farms is the hectare-weighted median, which corresponds to a farm size that separates the farm size distribution into two parts: 50% of the total area of the national farmland operated by the crop farms of a larger size and the other 50% by the crop farms of smaller size than the hectare-weighted median.

1. Based on sample data.
2. For Italy and Latvia, 2000 data are not available.
3. For the United Kingdom (England), 2009 data are used for 2010.
4. For Germany, 2003 data are used for 2000.
5. For the United States, 1997 data are used for 2000 and 2012 for 2010.
6. For Canada, 2001 data are used for 2000, and 2011 for 2010.

B. Dairy farms



Countries are ranked according to 2010 levels.

The mid-point statistics used to measure the distribution of dairy farm size is the livestock unit-weighted median.

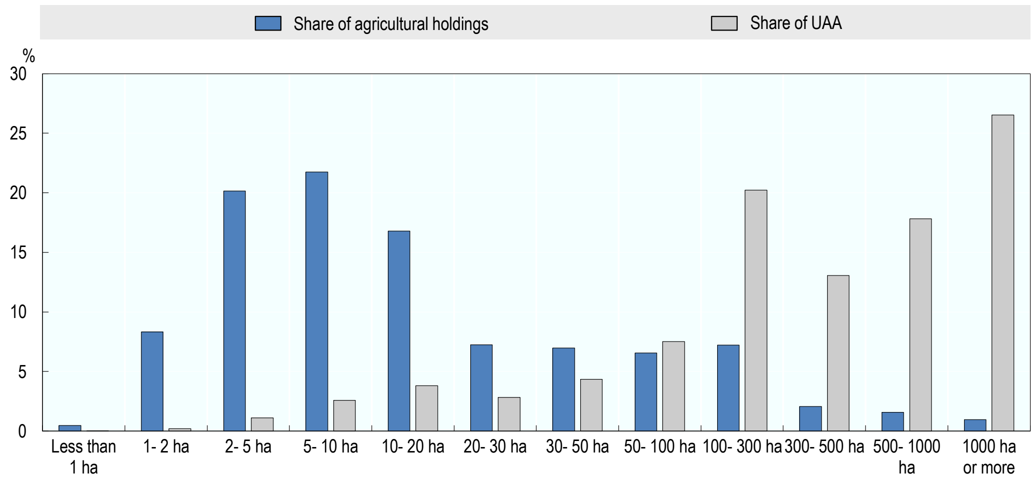
1. Based on sample data.
2. For Latvia, 2000 data are not available.
3. For Germany, 2003 data are used for 2000.
4. For the Netherlands, data are on all farms having cropland, dairy cows and pigs, respectively.
5. For Canada, 2001 data are used for 2000, and 2011 for 2010.
6. For the United Kingdom (England), 2009 data are used for 2010.
7. For the United States, 1997 data are used for 2000 and 2012 for 2010.

Source: Bokusheva and Kimura (2016), Tables B3 and B4, http://dx.doi.org/10.1787/5jlv81sclr35-en.

StatLink http://dx.doi.org/10.1787/888933653781

The Estonian agricultural sector is characterised by a **dualistic structure**, both in terms of the distribution of UAA as well as livestock production (Figure 2.7). In 2016, farms with less than 30 hectares (75% of holdings) managed 11% of UAA. At the same time, farms with over 1 000 hectares (1% of agricultural holdings) managed 27% of UAA, and farms with more than 300 hectares (5% of agricultural holdings) managed more than half (57%) of the UAA. The share of farms of more than 100 ha is higher than in other Baltic countries, and they operate a larger share of the UAA (almost 78%). Among selected countries in Table 2.A1.1, the Czech Republic is the only EU member state with a higher concentration of agricultural land in larger farms. Livestock production is particularly concentrated into micro (<1 ha) and large (≥500 ha) farms: 24% of total LU are in micro farms (mainly pig and poultry farms that do not have agricultural land and that have a very high livestock density), while 40% of LU are found in large farms (mainly cattle and pig farms) (Statistics Estonia, 2017).

Figure 2.7. Share of agricultural holdings and utilised agricultural area (UAA), by size class, 2016



Source: Statistics Estonia (2017), [AGS420], www.stat.ee.

StatLink http://dx.doi.org/10.1787/888933653800

Farm income and wealth

The value of assets per ha of UAA is highest in the smallest and largest farm size groups, however, larger farms have higher liabilities/assets ratio, which increase pressure on their viability in the periods of low market prices. Total farm income and farm income per unpaid farm (family) labour increases with farm size. In 2015, average annual gross wage in agriculture, forestry and fishing was EUR 11 388. If this is compared to farm income per unpaid farm (family) labour in different farm types and size groups, it is clear that smallest farms are not viable if they do not have additional income sources from off-farm jobs or pensions.

Food processing sector

Similar to many other countries, the structure of Estonia's food processing sector is also dualistic. In 2014, Estonia had 10 (2%) large (≥ 250 employees) enterprises, for which gross sales comprised 32% of the aggregate gross sales of food manufacturing industry (Table 2.A1.2). The proportion of large enterprises in Estonia is similar to other observed countries. However, the share of their aggregated turnover in industry's total is smaller in Estonia, indicating that large food manufacturing enterprises in Estonia are smaller than their competitors in the selected countries. Average turnover per enterprise among large Estonian food industry companies was EUR 51 million in 2014. This figure was exceeded by large Danish and Dutch food industry enterprises (by 11 and 10 times respectively) and smaller only in Latvia.

In recent years, the number of food processing enterprises has increased by one third — from 358 in 2010 to 477 in 2014. This increase is mainly due to an increase in micro enterprises of 1-9 employees. In 2010-14, the number of food processing enterprises in size classes 50-99, 100-249 and ≥250 employees also increased.

Investment in food processing has not kept up with investment in primary agriculture. For instance, over the period 2008-15, agriculture, fishing and aquaculture invested twice as much as food and beverage manufacturers, and crop and animal production, hunting and related service activities invested 2.5 times more that manufacturers of food products (Statistics Estonia, 2017).

Recent studies investigated the competitiveness of Northern Europe dairy chains. Main findings for Estonia, presented in Box 2.2, are that the Estonian dairy processing industry achieves low total factor and labour productivity, and lacks competitiveness in the raw milk market of Baltic countries.

Box 2.2. The competitiveness of the Estonian dairy processing industry

Studying the competitiveness of Northern European dairy chains, Jansik et al. (2014) concluded that the Estonian dairy processing industry is fragmented. Since foreign investors divested in the 2000s, the industry has had one main foreign owner, a Finnish company called Valio, which is the biggest manufacturer in terms of turnover with EUR 99 million of sales revenue in 2012. The four leading companies purchased 58% of raw milk in 2012. One of the challenges for Estonian dairy processors is efficiency. The assortment of consumer products (e.g. yoghurt) in a relatively small domestic market is wide, the series are small and there are frequent shifts to new flavours, which increase costs. Authors concluded that the average annual Total Factor Productivity (TFP) growth in Estonian dairy processing industry was merely 0.3% in the period from 2000-11, compared to 0.7% in Finland, 1.5% in Latvia, 2.4% in Lithuania, but negative TFP growth in Sweden and Germany.

Viira et al. (2015) found that Estonian and Latvian dairy processing industries lack competitiveness in the raw milk market of Baltic countries. While the Estonian dairy industry processed 74.8%, and the Latvian dairy industry processed 72.0% of collected raw milk in 2014, the Lithuanian dairy industry processed 118.7% of the volume of milk collected in Lithuania, i.e. raw milk was traded from Estonia and Latvia to Lithuania. This could be explained by a lack of milk processing capacity in the Estonian dairy industry. However, in the absence of official figures, some experts state that the existing milk processing capacity in Estonia is outdated and inefficient.

The productivity of the Estonian dairy industry, measured by the quantity of processed milk per employee per year falls significantly behind productivity in the Netherlands, Germany and Ireland (Table 2.1). In addition, the production value per kg of processed milk is lower than in the Netherlands, Finland, Germany and Latvia. Viira et al. (2015) concluded that in order to increase competitiveness, the Estonian dairy industry needs to consolidate, invest in automation to achieve higher processed milk volumes per employee, and to increase the value of production per tonne of processed milk. There have been some developments since. For example, the process of acquisition of one medium-sized player by another medium-sized player started in 2017. Moreover, EUR 15 million were allocated from RDP to build a new milk processing plant owned by a cooperative of dairy farmers.

Table 2.1. Characteristics of the milk processing industry in selected countries, 2013-15

	Estonia	Latvia	Lithuania	Nether-lands	Finland	Germany	Ireland
Production value, EUR million	344.2	362.6	990.3	10 916.9	2 473.6	27 288.9	3 738.9
Number of employees	2 065	3 165	7 507	13 692	6 177	43 884	6 900
Milk processed, 1000 tonnes	545.9	571.5	1 677.4	12 442.2	2 357.0	31 816.8	6 289.1
Milk processed per employee, tonnes	264.4	180.5	223.4	908.7	381.6	725.0	911.5
Production value per employee, EUR 1 000	166.7	114.5	131.9	797.3	400.4	621.8	541.9
Production value per kg of processed milk, EUR	630.6	634.4	590.4	877.4	1 049.4	857.7	594.5

Source: Eurostat (2017) http://ec.europa.eu/eurostat/data/database.

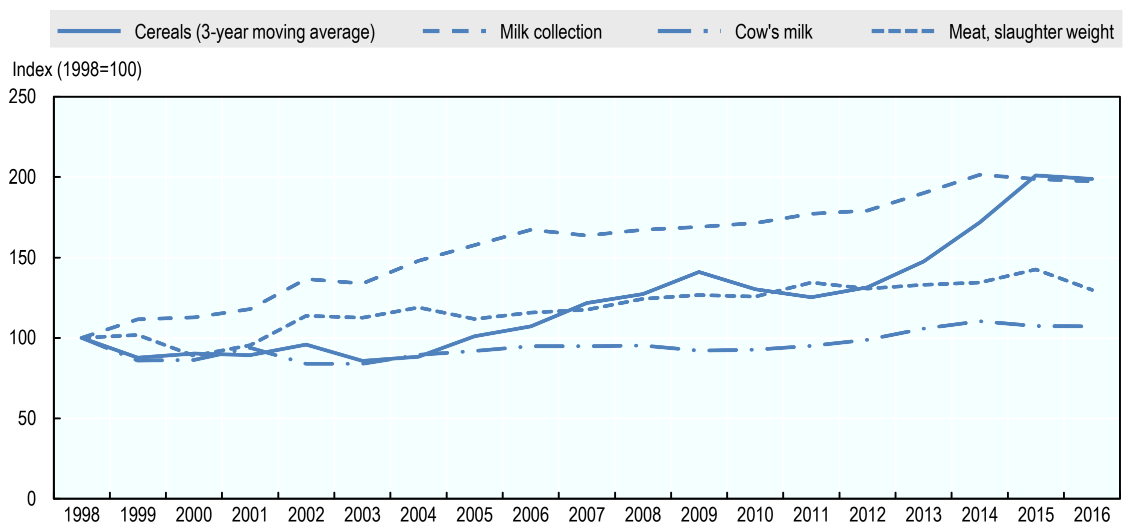
2.5. Agricultural output and trade

Output

Estonia's agricultural output is dominated by milk production, but cereal and oilseed production is increasing at a faster rate. Milk's share in the total value of agricultural production[3] declined from 32% in 2003-05 to 29% in 2014-16 (Figure 2.8). This declining share was driven by low farm gate milk prices in 2016 as well as rising cereal and oilseed production (from 20% in 2003-05 to 34% in 2014-16). Milk production increased only 7% from 1998 to 2016, but milk collection has increased 97% as improvements in milk quality and structural changes in dairy farming sector lead to a high share of milk production reaching processing firms. Over the same period (three-year moving average), cereal production increased by 99%, mainly due to rapid growth in yields, and meat production increased by 30%. However, in 2016, meat production declined by 8% compared to 2015, mainly because of the crisis in the pig meat sector after the outbreaks of African Swine Fever (ASF) in pig farms in 2015 and 2016.

Milk production in Estonia has fluctuated over the last two decades. After regaining independence, milk production in Estonia began to decline, hitting a low threshold of 610 000 tonnes in 2003. While the number of dairy cows decreased in Estonia by 57% over 1994-2013, as milk yields increased by 132% (Figure 2.13), total milk production recovered 1994 levels in 2013. Compared to other Northern Europe countries, milk production in Estonia has demonstrated the highest growth. Milk production continued to increase in 2014, but declined in 2015 and 2016. The withdrawal of milk quotas in the EU in 2015 (which was announced in 2008) led to a 7% increase in EU production volumes from 2008 to 2014 (Viira et al., 2015). This increase in supply has had a negative impact on milk producer prices across Europe and put many milk producers under economic pressure. An import ban issued by the Russian Federation — an important export market for Estonia — in August 2014 put further pressure on Estonian milk producers. From 2014-16, Estonia's milk production declined by 3%, the number of dairy cows decreased by 10% and the average annual milk yield increased by 7%.

Figure 2.8. Developments in meat, milk and cereals production, 1998 to 2016



Source: Statistics Estonia (2017), [AG04, AG10, AG11], www.stat.ee.

StatLink http://dx.doi.org/10.1787/888933653819

Meat production has increased over the last two decades, by 1.5% per year on average. The highest growth rate was for poultry meat (8.3% per year) and pig meat (1.6%), while beef production declined.[4] Pig meat accounted for about 55% of all meat production in 2016, compared to 54% in 1996 and 60% in 2006. During the same period, the share of poultry meat increased from 7.3% in 1996 to 18% in 2006 and 25.3% in 2016.

Pig meat production levels have suffered in the last couple of years due to ASF outbreaks. ASF was first diagnosed among the Estonian wild boar population in September 2014. In the third quarter of 2015, the first cases of ASF were confirmed in domestic pigs. While the disease outbreak at pig farms subsided in September 2015, there have been subsequent outbreaks in 2016 and 2017. Between 2015 and 2016, around 53% of pig farmers closed down their businesses due to the spread and threat of ASF. The number of pigs kept on farms decreased by 26%, dropping from 357 900 pigs in 2014 to 265 400 in 2016. The number of pigs and pig farmers is expected to decline further, especially on the account of small-scale farmers (farms with less than 50 pigs). However, pig meat production recovered its 2011 level of 50 000 tonnes in 2015 due to the liquidation of many pig farms. In 2016 pig meat production decreased by 15% compared to 2015 (EMÜ, 2016).

Trade

Estonia has a large trade deficit of agricultural and food products due to high imports of processed foods. The annual deficit peaked to over EUR 500 million in the late 1990s, but has declined since. In 2016, the balance of trade of agricultural and food products (HS chapters 01-23) was about EUR -317 million (Table 2.2). The trade surplus was largest for cereals and dairy products. The trade balances of live animals, fish, preparations of meat and fish, animal or vegetal fats and oils and vegetable planting materials were also positive. At the same time, Estonia was a net importer of fruits, vegetables and a number of prepared food categories (e.g. meat, products of the milling industry and cereals, flour, starch or milk).

The composition of Estonia's agro-food trade suggests the food manufacturing industry is not as developed as primary production. Estonia's imports of agro-food products are mainly for household consumption (over 70%), while the country exports a larger share of agro-food products for industrial use than the EU average (Figure 2.9). The lower processing capacity is particularly clear at the sub-sector level: Estonia is a net exporter of cereals, but a net importer of processed cereals — and a net exporter of live animals, but a net importer of meat.

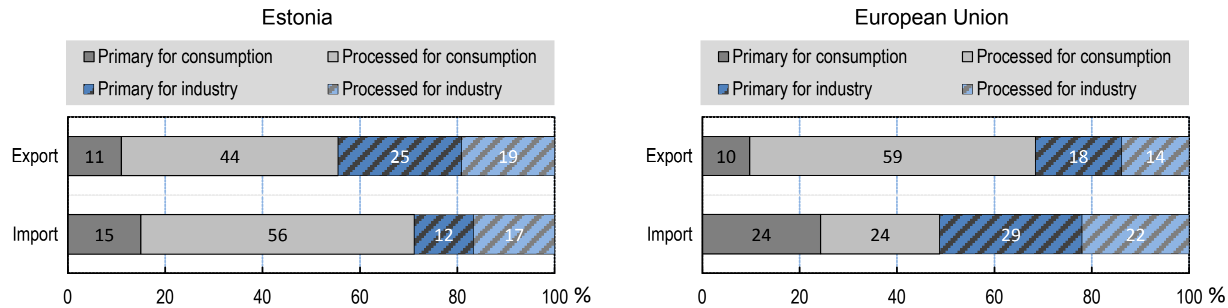
Table 2.2. Import and export of agricultural and food products in Estonia, 2016

	Import	Share of total imports	Export	Share of total exports	Balance
HS Chapter	Million EUR	%	Million EUR	%	Million EUR
10 Cereals	15.2	0.1	106.8	0.9	91.6
04 Dairy products, eggs, honey	72.7	0.5	141.9	1.2	69.2
01 Live animals	7.6	0.1	39.7	0.3	32.1
15 Animal or vegetable fats and oils	28.1	0.2	46.4	0.4	18.3
03 Fish	93.2	0.7	111.4	0.9	18.2
16 Preparations of meat and fish	57.1	0.4	65.6	0.6	8.6
12 Oil seeds	16.4	0.1	18.9	0.2	2.5
14 Vegetable planting materials, other vegetal products	0.2	0.0	0.4	0.0	0.3
13 Lac, gums, resins	1.6	0.0	1.1	0.0	- 0.5
05 Other animal products	4.5	0.0	4.1	0.0	- 0.5
21 Miscellaneous edible preparations	111.8	0.8	110.2	0.9	- 1.6
11 Products of milling industry	16.8	0.1	10.9	0.1	- 5.9
19 Preparations of cereals, flour, starch or milk	86.4	0.6	63.6	0.5	- 22.8
06 Live trees and plants	29.0	0.2	3.2	0.0	- 25.8
07 Vegetables	62.4	0.5	33.7	0.3	- 28.8
17 Sugars and sugar confectionery	46.4	0.3	10.8	0.1	- 35.6
18 Cocoa and cocoa preparations	62.4	0.5	19.6	0.2	- 42.8
20 Preparations of vegetables and fruits	65.9	0.5	19.0	0.2	- 46.9
09 Coffee and tea	63.5	0.5	14.8	0.1	- 48.6
23 Residues and waste from food industry	65.2	0.5	15.9	0.1	- 49.3
02 Meat	100.0	0.7	47.2	0.4	- 52.8
08 Fruit	111.6	0.8	26.3	0.2	- 85.3
22 Beverages, spirits and vinegars	277.1	2.1	166.3	1.4	- 110.8
Total	**1 394.9**	**10.3**	**1 077.6**	**9.1**	**- 317.2**

Source: Eurostat (2017), Traditional international trade database (ComExt), http://ec.europa.eu/eurostat/data/database.

Figure 2.9. Composition of agro-food trade, 2016

Intra and extra EU trade



Numbers may not add up to 100 due to rounding.

Source: Eurostat (2017), Traditional international trade database (ComExt), http://ec.europa.eu/eurostat/data/database.

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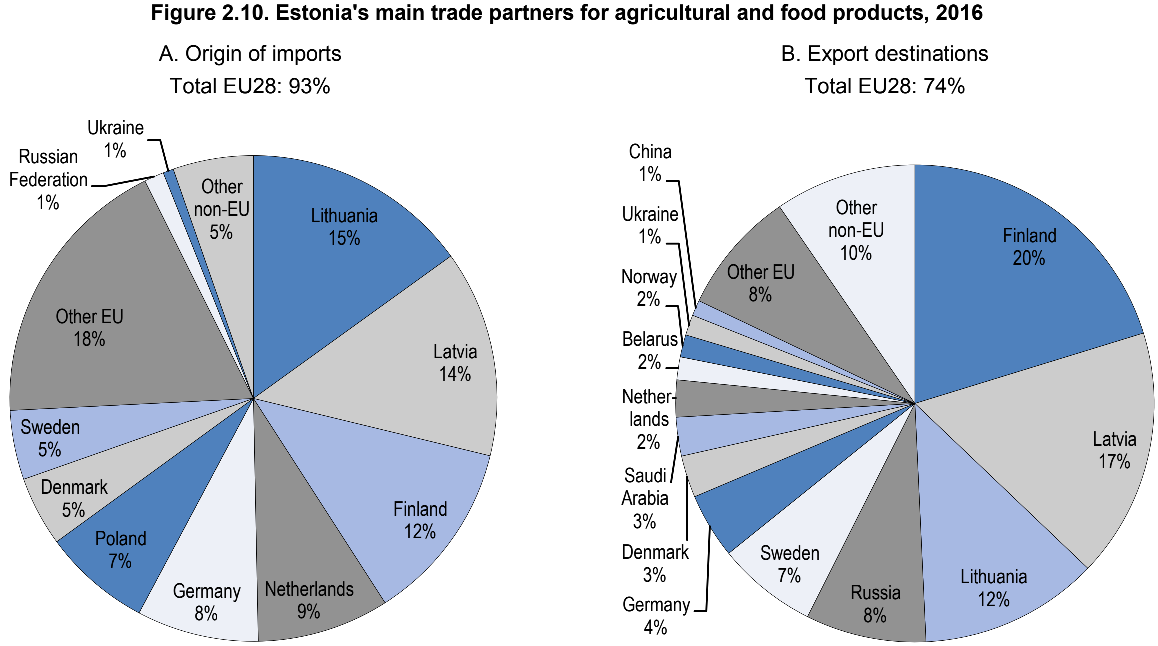
Estonia's trade in agricultural and food products is primarily EU-focused (Figure 2.10). In 2016, 93% of Estonian agricultural and food products originated from EU28 countries, and 74% of Estonian agricultural and food exports were exported to them. Latvia, Lithuania and Finland are the main trading partners for agricultural and food products. Other Northern European countries also account for a significant share of Estonian agricultural and food imports, and Sweden receives a significant share of Estonian agricultural and food exports. As noted previously, trade with the Russian Federation has markedly declined since the issuance of an import ban in August 2014 and approximately two-thirds of Estonian exports to Russia is comprised of drinks, alcohol and vinegar.

Figure 2.10. Estonia's main trade partners for agricultural and food products, 2016



Definition of agri-food products HS 01 to 23.

Source: Eurostat (2017), Traditional international trade database (ComExt), http://ec.europa.eu/eurostat/data/database.

StatLink http://dx.doi.org/10.1787/888933653857

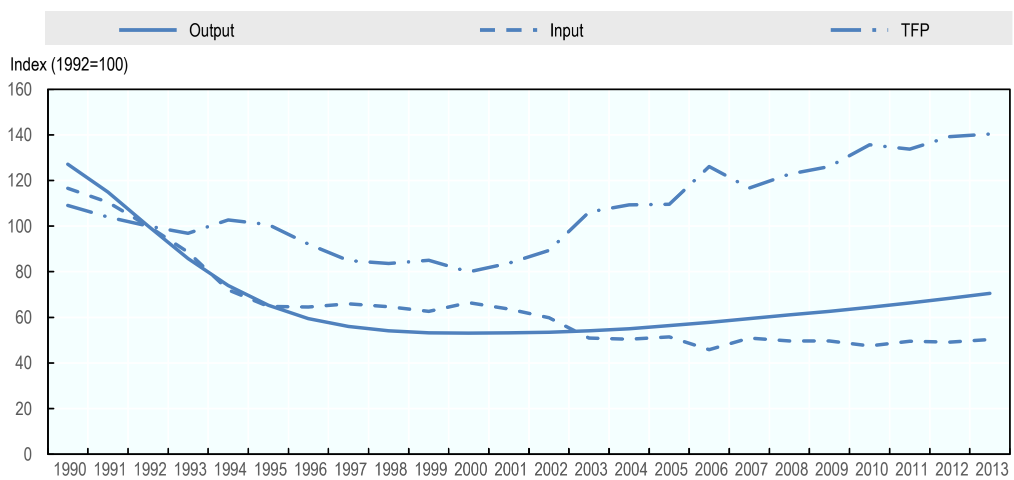
2.6. Trends in productivity

Total Factor Productivity

Agricultural TFP has increased strongly since 2000, following a decline in the 1990s when output levels declined more than input levels (Figure 2.11; Table 2.3). The largest declines were in the use of fertilisers and the number of animals. Machinery was the only input to increase. The reduction in agricultural labour was sustained over the period 1990-2013, leading to higher labour productivity.[5] In the early 2000s, TFP started to recover as total output levels increased in both livestock and crop production. Over the period 2000-13, the increase in output occurred while total input levels continued to decline, mainly due to lower labour and animals. Capital improvements in the 2000s have benefited Estonia's agricultural sector. Policies to stimulate investment have triggered more intensive use of intermediate inputs, the introduction of modern technology and rapid growth in knowledge.

Productivity growth in Estonia's agricultural sector has exceeded growth rates in most comparable countries and the EU average over the last decade. As illustrated in Figure 2.12, the average TFP index in Europe has experienced strong growth. However, in 2013, Estonia's TFP growth exceeded the EU average and all northern European countries excluding Denmark and the Netherlands.

Figure 2.11. Trends in the Total Factor Productivity (TFP) of Estonian primary agriculture, 1990 to 2013



Source: USDA (2016), Economic Research Service, International Agricultural Productivity: www.ers.usda.gov/data-products/international-agricultural-productivity.aspx (accessed January 2017).

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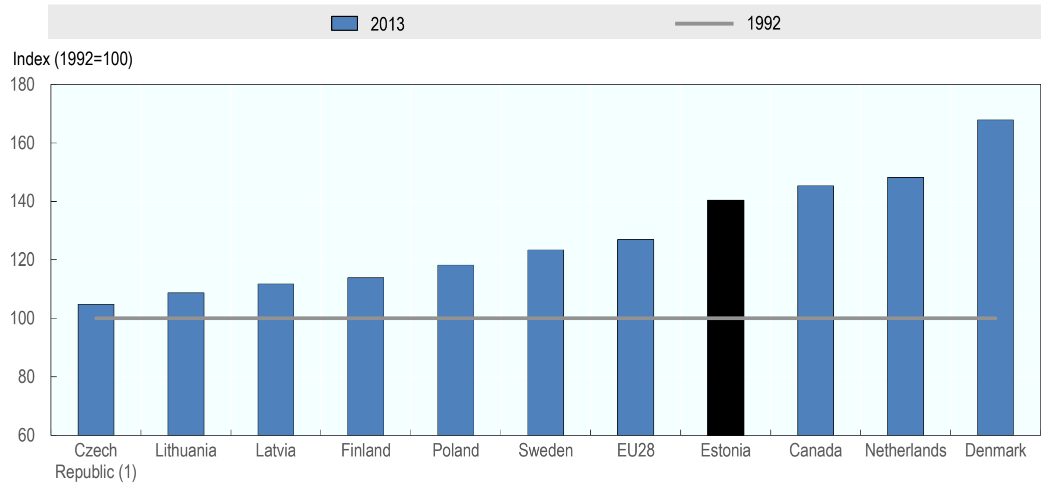
Table 2.3. Decomposition of Estonian Total Factor Productivity growth, 1991-2013

Average annual change, LN (T/ (T-1))

	Output	Labour	Land	Livestock	Machinery	Fertiliser	Feed	TFP	Total Inputs
1991-01	- 0.0885	- 0.0785	- 0.0336	- 0.1166	0.0456	- 0.2043	- 0.0312	- 0.0297	- 0.0588
2001-10	0.0223	- 0.0825	0.0017	- 0.0056	- 0.0166	0.0059	- 0.0292	0.0474	- 0.0251
2001-13	0.0246	- 0.0770	0.0052	- 0.0021	- 0.0050	0.0412	- 0.0126	0.0393	- 0.0147

Source: USDA (2016), Economic Research Service, International Agricultural Productivity, www.ers.usda.gov/data-products/international-agricultural-productivity.aspx (accessed January 2017).

Figure 2.12. Agricultural Total Factor Productivity growth, by country, 1992 and 2013



1. As data for Czech Republic are unavailable, Czechoslovakian data are used.

Source: USDA (2016), Economic Research Service, International Agricultural Productivity, www.ers.usda.gov/data-oducts/international-agricultural-productivity.aspx (accessed January 2017).

StatLink http://dx.doi.org/10.1787/888933653895

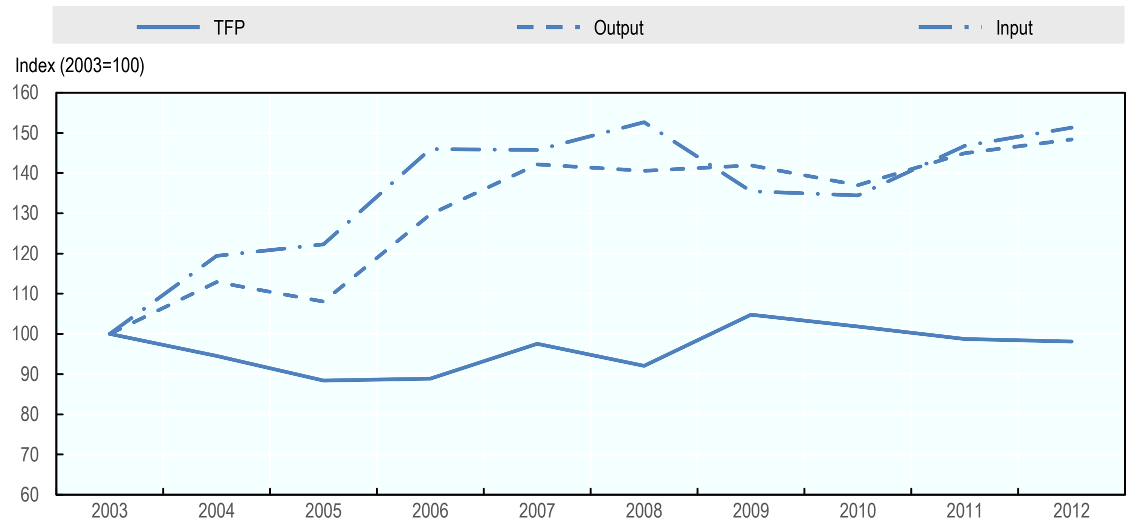
Dairy productivity

While, TFP is generally not available by sector in official statistics, it has been estimated for the dairy sector of Estonia using farm level data (Kimura and Sauer, 2015). **Dairy TFP** has fluctuated over the last decade (Figure 2.13). Following EU accession, input levels increased at a faster rate than output levels — triggering a decline in TFP in the mid-2000s. TFP partially rebounded in the late 2000s. Increases in milk yields have contributed to TFP growth.

Over the last two decades, average milk yields in Estonia have achieved faster growth rates and started to catch up the yields in many selected countries (Figure 2.14). In 1994, the average milk yield in Estonia and other member states that joined the European Union in 2004 was approximately half that in Canada, Denmark, Finland, the Netherlands and Sweden. Through technological development, improved feeding, breeding and structural change, milk yields in Estonia surpassed 8 tonnes/cow/year in 2014, above the Eastern European average and nearing the rates of Canada, Denmark, Finland, the Netherlands and Sweden. Growing fast since the recovery of milk markets (and with no quota to constrain production), Estonian milk yields are expected to reach approximately 9.5 tonnes per cow in 2017.

A first driver of productivity growth in Estonia's dairy farm sector has been **resource reallocation**. As illustrated in Figure 2.15, resource reallocation towards more productive farms stimulated productivity growth during the 2003-12 period (Kimura and Sauer, 2015). Indeed, benefiting from economies of scale, larger Estonian farms recorded higher milk yields and higher livestock density. The largest 25% farms accounted for 90% of milk production in recent years. Under this dualistic sector structure, the evolution of sector-level productivity is largely driven by improvements in a small number of large farms. As a result, the productivity difference between large and small farms increased overtime.

Figure 2.13. Evolution of Total Factor Productivity (TFP), output and input indices of Estonian dairy farm sector, 2003 to 2012



Source: Kimura and Sauer (2015), "Dynamics of dairy farm productivity growth: Cross-country comparison", http://dx.doi.org/10.1787/5jrw8ffbzf7l-en.

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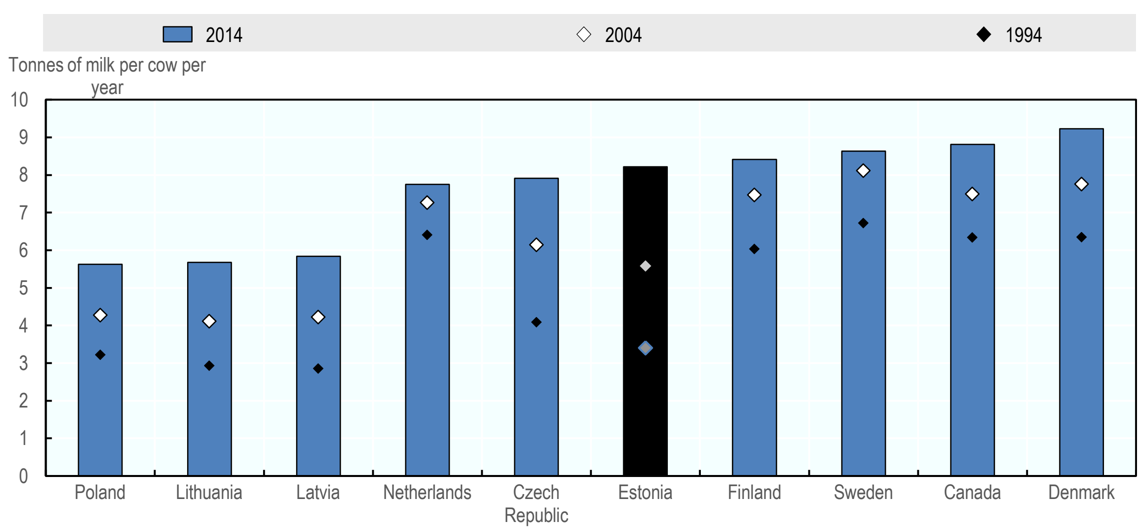
Figure 2.14. Developments in milk yield, 1994, 2004 and 2014

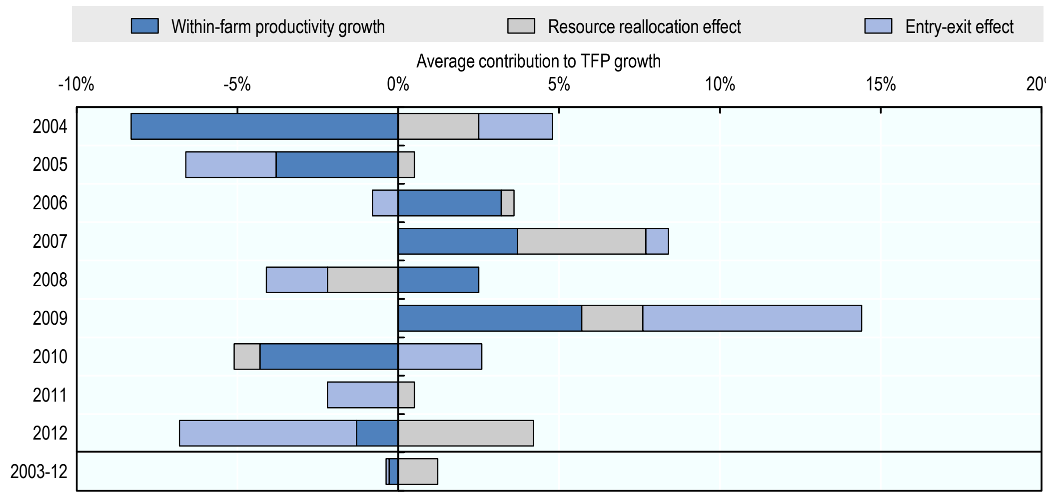


Countries are ranked according to 2014 levels.

Source: FAO Statistics Division (2016), FAOSTAT, Livestock Primary database [Milk Animals; Production; milk, whole fresh cow], www.fao.org/faostat/en/.

StatLink http://dx.doi.org/10.1787/888933653933

Figure 2.15. Decomposition of Total Factor Productivity (TFP) growth in the Estonian dairy farm sector, 2004 to 2012



Source: Kimura and Sauer (2015), "Dynamics of dairy farm productivity growth: Cross-country comparison", http://dx.doi.org/10.1787/5jrw8ffbzf7l-en.

StatLink http://dx.doi.org/10.1787/888933653952

The **exit of inefficient farms** has also been an important driver of productivity growth in Estonia's dairy farm sector during selected years (Kimura and Sauer, 2015). In particular, due to a low milk price in 2009 and 2010, many small and less productive farms stopped producing milk and exited the market. However, exit of efficient farms from the dairy specialist category in the survey appears to have reduced productivity growth in 2011 and 2012 (Figure 2.13).

Rapid **technological change** has contributed to productivity growth in dairy farms. In line with the EU directives on agri-environmental issues and their associated investment subsidies, most feeding and milking technologies have been upgraded, and most new farms have opted for liquid manure systems since 2001 (Box 2.3).

In line with the sector-wide trends (Figure 2.14), **low labour productivity** is a key barrier to productivity growth in the dairy sector. According to Kimura and Sauer (2015), labour input per cow had a negative correlation with productivity.

Box 2.3. Estonian dairy farms' technologies

In 2013, the Institute of Economics and Social Sciences of the Estonian University of Life Sciences (EMÜ) conducted a farm survey on the *Efficiency of utilisation of the main production resources in Estonia*. The main aim was to gather information about the technologies used by dairy farms; 326 milk farms responded that had in total 366 dairy barns.

Dairy barns: Most Estonian dairy cows are in larger, more recent barns with loose housing. 67% of the barns had less than 100 places for dairy cows, but these small barns accounted for 15% of total places. Therefore 85% of places for dairy cows were in larger barns with more than 100 places. 70% of barns had tethered housing, and included 30% of the total number of places for dairy cows while the remaining 30% of barns were of the more modern loose housing type and included 70% of the places. 80% of barns with tethered housing were for less than 100 cows and most of them were constructed before 2001. 70% of the loose housing barns had space for more than 100 cows and most of these were constructed after 2001.

Milking technologies: 38% of the dairy barns had pipeline milking system, and 30% bucket milking; 26% had milking parlour or carousel, and 6% had automated milking system (robots). Despite the high share of barns with pipeline and bucket milking (68%), the share of cows milked with these technologies is quite small (26%). It means that 74% of cows are milked with up-to-date milking technologies. The pipeline and bucket milking systems are more widespread in smaller and older barns, in which the average number of dairy cows is 53. Contemporary milking systems are widespread in bigger and new barns: the average number of dairy cows in barns with milking parlours or carousels is 323; and 256 in the robot milking barns. New barns (constructed after 2001) usually have milking parlours or robots.

Box 2.3. Estonian dairy farms' technologies (cont.)

Feeding of dairy cows: the two main feeding systems are total mixed ration (TMR) feeding (22% of the farms) and regular feeding (78%) with unlimited roughage and rationed concentrates. In smaller barns, usually regular feeding is used, while the larger barns use the TMR technology.

Grazing: whether dairy cows can graze or not depends on the herd size and used technologies. Considering the large proportion of small farms, it is evident that in most of the farms (52%, average 46 places for dairy cows per barn) cows are grazed 24 hours per day during the grazing period. In 25% of the farms (average 107 places for dairy cows in the barn), cows graze only in daytime during the grazing period. In 21% of the farms (average 377 places for dairy cows), cows do not graze and are fed with silage all year round. In 2% of the farms (average 390 places for dairy cows), cows are not grazed but during the summer, fresh cut grass is fed to dairy cows. In 77% of farms, cows grazed during the grazing period, and in 23% of the farms, cows were kept indoors the whole year round.

Manure: in 64% of barns, a solid manure system was used. Most of these barns were older and smaller, and not reconstructed. New or renovated barns (25% of all barns) usually have liquid manure system. 10% of barns use combined system — both solid and liquid manure. Manure is usually used in the farm. Manure application technology depends on the size of the farm and type of manure. Smaller farms use broadcast spreader or spray-based slurry spreading, larger farms use various manure application technologies that enable to inject manure into the soil immediately.

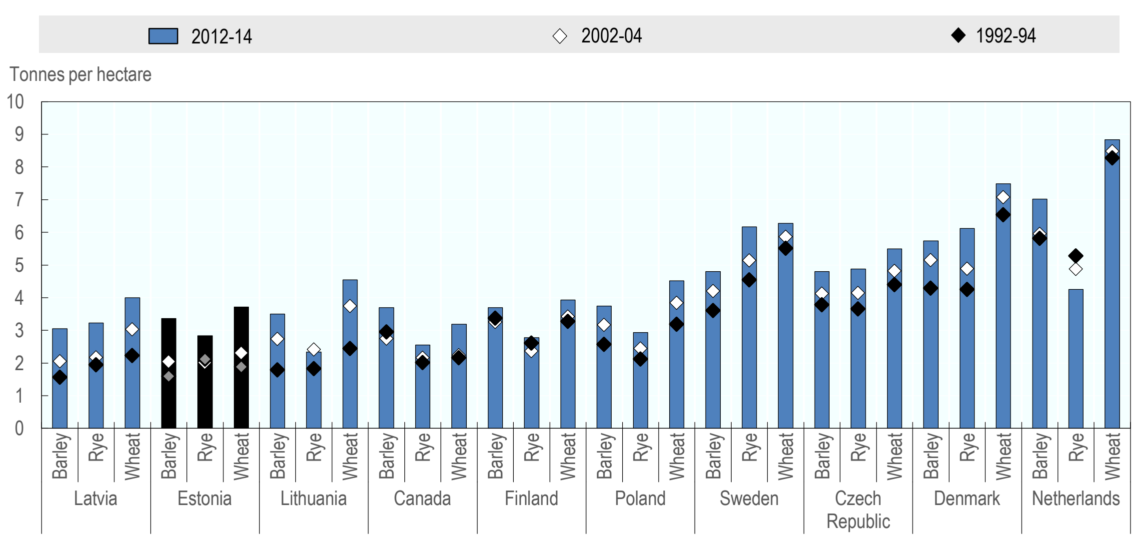
In Estonia, the rapid technological change in dairy farms started in 2001. Since then, most of the barns that are built are uninsulated (cold), feeding and milking technologies are upgraded, and manure systems are changed to liquid systems. These changes have been in line with the EU directives related to the agri-environment and have been supported through CAP funding.

Source: EMÜ (2013a); Luik and Viira (2016).

Crop yields

Notwithstanding a low base level in the early 1990s, Estonia's barley and **wheat yields** have achieved the highest growth rates among selected countries over the last two decades. From 1992-94 to 2012-14, they increased by 111% and 98% respectively, followed closely by Lithuania and Latvia, while rye yields increased most in Latvia, almost twice as much as in Estonia and Lithuania (Figure 2.16). Despite these increases, Baltic countries still achieve relatively low yields compared to the Netherlands, Denmark, Sweden and the Czech Republic. With its northernmost location, Estonia's crop yields are close to those in Finland, but wheat yields are lower than in Southern neighbours.

Figure 2.16. Developments in cereal yields, 1992-94, 2002-04 and 2012-14



Countries are ranked according to barley 2012-14 levels.
All cereals harvested for dry grains.

Source: FAO Statistics Division (2016), FAOSTAT, Crops database [Production, Area harvested], www.fao.org/faostat/en/.

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Box 2.4. Estonian crop farms' technologies

In 2013, the Institute of Economics and Social Sciences of the Estonian University of Life Sciences (EMÜ) conducted a farm survey on the Efficiency of utilisation of the main production resources in Estonia. The main aim was to gather information about the technologies used by crop farms. 333 crop farms responded. Farms were divided into three size groups, by agricultural land use: <100 ha (small); 100-399.9 ha (medium); ≥400 ha (large). The survey included 141 smaller farms (42%), 137 medium farms (41%) and 55 larger farms (17%).

The surveyed farms used various precision farming techniques, mainly in relation to crop protection (36%), sowing (30%) and fertiliser application (29%). For tillage and grain harvesting precision farming techniques were used less often, 11% in both cases. Precision farming techniques were more often applied in larger farms — 67% in crop protection, 55% in fertiliser application and 45% in sowing — but less in smaller and medium farms — respectively 26% and 34% in crop protection, 19% and 19% in fertiliser application and 26% and 28% in sowing.

Among precision farming techniques, assisted steering systems were the most widespread (30% of the respondents). Other options were used less frequently: precision crop management (12%); geomapping (9%); variable rate technology (ability to adapt parameters on a machine to apply, for instance, seed or fertiliser according to the exact variations in plant growth, or soil nutrients and type) (5%); measuring soil parameters (e.g. nutrients and moisture) at precise points (3%).

Among the larger farms 67% used precision steering systems and 31% geomapping of crop quantity and quality. Thus, operators of larger farms have adopted innovative technologies more often than those of smaller and medium sized farms.

Direct seeding and combined seeding, that help mimise tilling and costs, have become more widespread.

Table.2.4. Adoption of technology in crop farms, 2013

Farm size	Direct seeding	Combined seeding (seeds + fertiliser)	Combined seeding (seeds + fertilisers + soil tillage equipment)	Seed drill	Seed drill with soil tillage equipment
<100 ha	11%	50%	9%	28%	8%
100-400 ha	24%	35%	23%	18%	17%
>400 ha	18%	13%	29%	29%	29%
Total	**17%**	**38%**	**18%**	**24%**	**15%**

Source: EMÜ (2013a).

Larger and medium farms used more often seeding in combination with tillage equipment, while smaller farms used more often seeding without combined tillage equipment.

Soil samples were regularly taken by 85% of larger farms, 75% of medium farms and 49% of smaller farms. This indicates that larger farms had more information about the soil condition.

The respondents were also asked about their plans for adopting new technologies. Over half of the respondents intended to adopt minimised tilling and precision farming techniques. About three-quarters intended to start using certified seeds. Direct seeding will be more likely adopted by larger and medium farms, while smaller farms are more likely to continue using ploughing-based technologies.

Source: EMÜ (2013a).

Food processing productivity

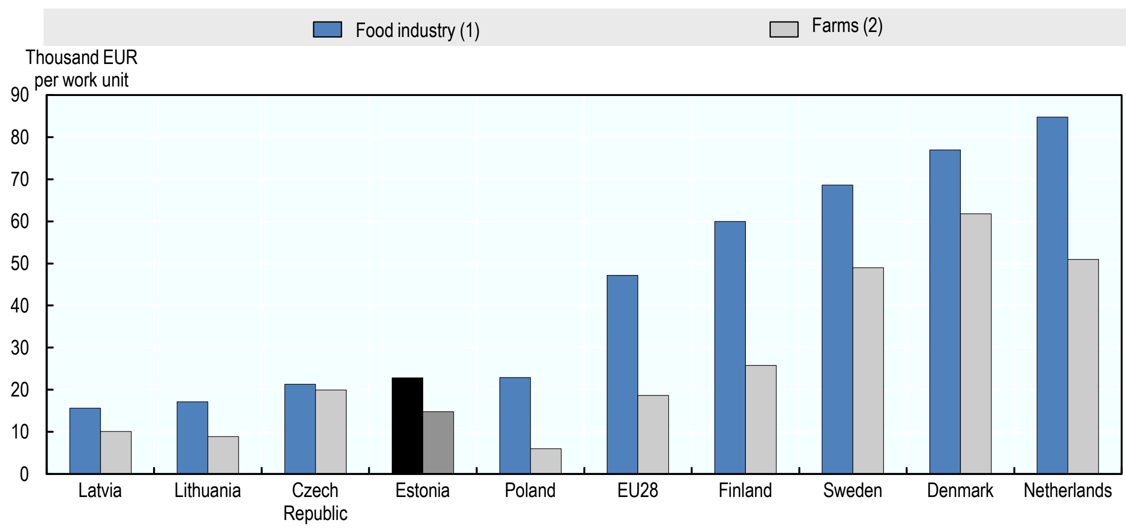
Estonia's **food processing** sector has been characterised by low productivity growth in recent years. For instance, the Estonian dairy processing industry had average annual TFP growth of merely 0.3% in the 2000-11 period (Box 2.2). As a result, Estonia's dairy industry processed only 75% of the volume of raw milk collected in 2014, whereas Lithuania's dairy industry processed 119% of the milk collected in Lithuania. In other words, raw milk was traded from Estonia to Lithuania — indicating a lack of competitiveness in milk processing (Viira et al., 2015).

A first barrier to productivity growth in the food processing sector is lack of investment and **low labour productivity.** In 2014, value added at factor cost per employed person was EUR 23 300 (Figure 2.17). While Estonia exceeded the Latvian, Lithuanian and Czech Republic's figures, it is almost on par with the performance of food manufacturers in Poland. Compared to Scandinavian countries, value added per employed person in the Estonian food industry is approximately three times lower. While labour productivity in the food processing sector is higher than in agriculture in Estonia, the labour productivity gap between the two is low compared to other countries (e.g. the Netherlands, Poland, Sweden, EU28) shown in Figure 2.17.[6]

Lower levels of **automation** also constrain productivity growth for the Estonian food processing industry. For instance, as outlined in Box 2.3, automation is an important barrier to the development of Estonia's milk processing industry: some experts have highlighted that current equipment is outdated and inefficient. Investing in automation would help to achieve higher processed milk volume per employee (Viira et al., 2015). The industry fragmentation also limits productivity growth.

Figure 2.17. Labour productivity in food manufacturing companies and farms, selected countries, 2015

Value added per work unit (1, 2)



Countries are ranked according to food industry levels.
1. Value added at factor costs, EUR 1 000 per employee.
2. Farm net value added, EUR 1 000 per Annual Work Unit (AWU).

Source: Eurostat (2017) [sbs_sc_sca_r2] http://ec.europa.eu/eurostat/data/database, FADN (2017b), http://ec.europa.eu/agriculture/rica/database/database_en.cfm.

StatLink http://dx.doi.org/10.1787/888933653990

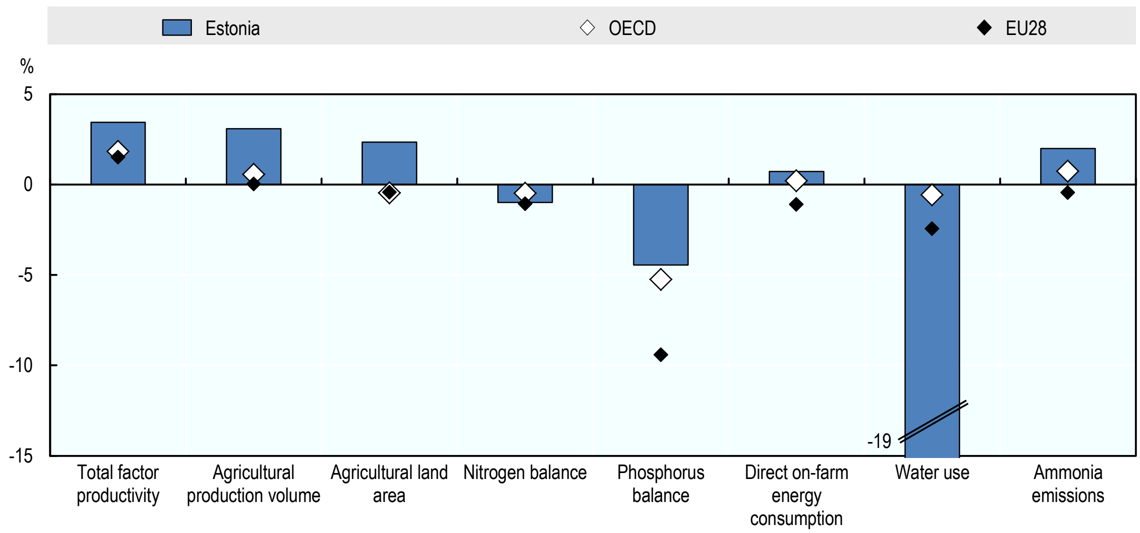
2.7. Trends in natural resource use and the state of the environment

Over the last decade, Estonia's TFP growth paralleled increases in certain agri-environmental pressures but decoupled from trends in others (Figure 2.18 and Table 2.A1.3). In particular, Estonia's production volume increased at a faster rate than agricultural land area due to TFP growth, among other factors. Over the same period, the OECD and EU15 maintained agricultural production levels, while reducing agricultural land area. Estonia's growth in TFP, production volume and land area also surpassed the trends in the Netherlands, Canada, the Czech Republic, Denmark, Finland, Latvia and Poland.

Over the same period, total direct on-farm energy consumption increased, at a rate surpassed only by Canada and Latvia, but the increase was lower than that of agricultural production, indicating more efficient energy use. This upward trend could be due to the shift in production from small, labour-intensive farms to larger, capital-intensive farms. Ammonia emissions increased at a faster rate than all other comparator countries, in spite of a decline in the number of dairy cows. Moreover, Estonia's phosphorus deficit increased, while phosphorus surpluses in the OECD, EU and several comparator countries declined at faster rates. At the same time, a decoupling can be seen between TFP growth and Estonia's nitrogen balance: Estonia's nitrogen surplus per ha decreased, at a faster rate than the OECD average and a slightly lower rate than the EU15 and EU28. Estonia's agricultural water abstraction is very low.[7] The rest of this section discusses these and other environmental trends in more detail.

Figure 2.18. Developments of environmental indicators for agriculture, Estonia, OECD and European Union, 2002-04 to 2012-14

Average annual percent change 2002-04 to 2012-14, or nearest available period



Source: OECD (2017b), Agri-environmental Indicators, www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm ; USDA (2016), Economic Research Service Agricultural Productivity Database for Total Factor Productivity, www.ers.usda.gov/data-oducts/international-agricultural-productivity.aspx.

StatLink http://dx.doi.org/10.1787/888933654009

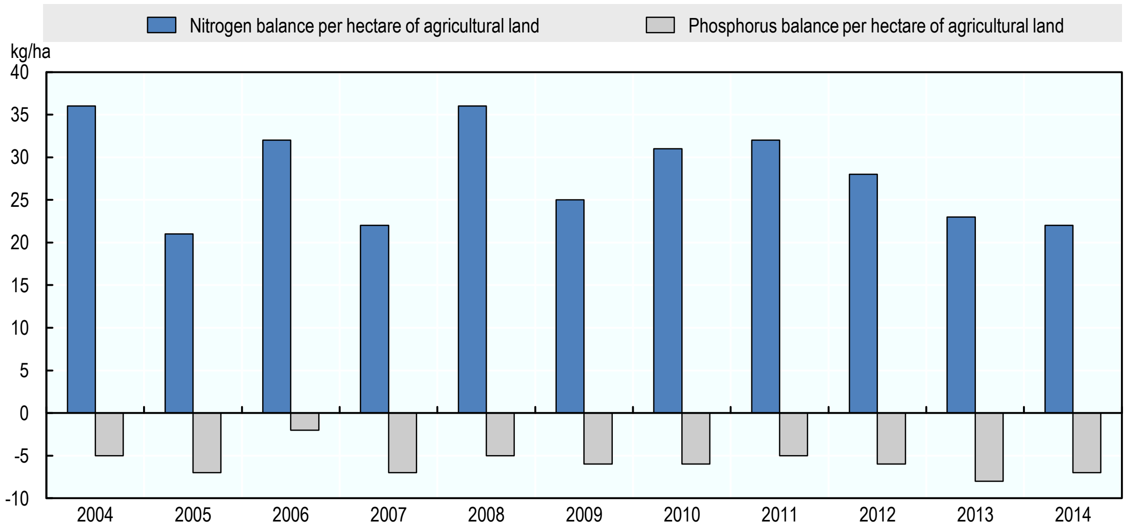
Inputs

Over the last decade, Estonia's **Nitrogen (N) balance** per ha of agricultural land was positive but declined at a faster rate than many comparative countries — a positive direction for sustainability (Figure 2.19). From 2004 to 2012, the N balance fell significantly, from 36 to 22 kg/ha in Estonia. During the same period, the N balance fell from 64 to 59 in the EU15 and 67 to 65 in the OECD area. The improvement in N balance in Estonia is mainly due to the higher productivity of crops: crop production increased faster than fertiliser use. Some improvement also occurs in livestock as manure application is stable, while animal production increases (Figure 2.8).

Estonia's Phosphorus (P) deficit has increased in recent years. From 2004 to 2013, Estonia's **P balance** fell from -5.0 to -8.0. During the same period, the P surplus of many comparator countries was reduced; for instance, the EU15 balance fell from 7.8 to 5.5 and the OECD average fell from 6.0 to 3.0. Higher crop production per fertiliser use due to policy shifts since EU accession as well as a declining number of agricultural animals (and thus a reduction in manure production, Box 2.3) may be contributing to Estonia's growing deficit. In the long term, such trends may lead to a decline in both soil fertility and productivity growth.

Certain support schemes may be exacerbating the P deficit. For enterprises benefiting only from the Single Area Payment Scheme (SAPS), the average P balance was negative in only 2 out of 11 years from 2004 to 2014. For enterprises receiving support from the agri-environmental management scheme, the average P balance was negative in 8 out of 11 years. For organic farms the P balance was negative for all 11 years. While only a correlation, this trend raises concern that the P deficit may further increase as the area under organic farms and farms supported from the agri-environmentally friendly management scheme continues to expand (ARC, 2016; ELF, 2016).

Figure 2.19. Nitrogen and phosphorus balance[1] in Estonia, 2004 to 2014



1. The gross nitrogen (phosphorus) balance (surplus or deficit) calculates the difference between the nitrogen (phosphorus) inputs entering a farming system (i.e. mainly livestock manure and fertilisers) and the nitrogen (phosphorus) outputs leaving the system (i.e. the uptake of nitrogen/phosphorus for crop and pasture production). Here, balance (surplus or deficit) expressed as kg nitrogen per hectare of total agricultural land.

Source: OECD (2017b), Agri-environmental Indicators, www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm.

StatLink http://dx.doi.org/10.1787/888933654028

Estonian **pesticide** sales have rebounded from low levels in the 1990s, but remain well below sales in most other EU and OECD countries. From 2011 to 2013, Estonia's pesticide sales increased from 0.49 to 0.59 kg of active ingredient/ha.[8] During the same period, the EU28 average was four times higher, but declining (from 2.11 to 2.02 kg/ha). Meanwhile, the OECD average increased from 0.86 to 0.89 kg/ha (FAOSTAT, 2016).

Sustainability issues may also vary according to farm size. As illustrated in Table 2.A1.4, larger farms (>100 ha) have higher average wheat yields, but also have higher intensity of fertilisers and pesticide sales per ha. On the other hand, smaller farms (<100 ha) appear to achieve higher average wheat yield per EUR spent on fertilisers and pesticides.

Water

The majority of Estonia's abundant water resources are in good status, but pressures from nutrient use and other sources threaten **water quality** in certain regions. Groundwater resources are estimated at 4 000 million m³/year. Internal renewable surface water resources are estimated at 11 712 million m³/year in 2013 (FAO, 2016). More than 90% of Estonia's groundwater — and 70% of Estonia's surface water bodies — have good ecological and chemical status. However, eutrophication due to nutrient loads from diffuse and point sources threatens sustainable management of agricultural and water resources in certain regions — in particular, the Nitrate Vulnerable Zone in Central and North-Eastern Estonia (OECD, 2017c).

Water use in agriculture draws primarily on surface water and has decreased in recent decades. In 2014, total water withdrawal was estimated at 1 720 million m³. Around 88% of total water withdrawal was withdrawn from surface water, 3% from groundwater and 9% from mining water (FAO, 2016). Less than 5 million m³ (0.3%) of total water withdrawal was withdrawn for agricultural purposes (including irrigation, livestock watering and cleaning, forestry and aquaculture). From 2000 to 2014, water use in Estonian agriculture decreased on average by 5% annually. This decrease is due in great part to a decline in certain forms of agricultural production – such as the area under orchards and berry gardens and the number of farm animals. Over the same period, average water use has also declined in Canada and the OECD area.

In terms of **water-related infrastructure**, irrigation use is minimal and declining but drainage is growing in importance. Falling from 3 680 ha in 1995, the total area equipped for irrigation was estimated at only 458 ha (of which 326 ha were actually irrigated) in 2010. However, drainage is more relevant: it is estimated, that without drainage about half of the land for agricultural production would suffer from waterlogging (EMÜ, 2013b). In 1975, about 390 000 ha of agricultural land were drained. In 1995, about 732 400 ha, or almost 85% of the cultivated land, were drained, of which 650 000 ha (89%) are equipped with subsurface drainage systems (FAO, 2016).

Biodiversity

Trends in agro-**biodiversity** in recent years may have implications for the productivity and sustainability of the agricultural sector. Pollinators, for instance, are affected by agricultural practices and at the same time affect yields. According to the Agricultural Research Centre (ARC) monitoring of bumblebee populations carried out as part of the evaluation of agri-environment measures, the population of bumblebees in agricultural landscapes displays a slightly positive trend over the recent period 2009-16 (ARC, 2017). It appears that support for environmentally-friendly practices and organic agriculture has had a positive impact on pollinators. On the other hand, Estonia's honeybee population has reportedly declined (MRA, 2016b).

The farmland bird index is another indicator of agrobiodiversity, which has been monitored since 1983 in Estonia. As is the case across Europe, the index for Estonia has a declining trend – the index value (based on 2000=100) was 75.4 in 2015, with significant annual variations. The number and status of birds is the highest in organic farming areas. This is probably caused by the prohibition of mineral fertilisers and synthetic pesticides, thereby increasing the birds' food supply. Another important reason is the larger share of grasslands in organic land use. Extensively-managed grasslands offer a more permanent population site for bird. At the same time, no significant differences can be seen between areas applying support for agri-environmentally friendly management schemes or only for Single Area Payment Scheme support (ARC, 2016).

Ammonia

Estonia achieved a significant decline in **Ammonia** (NH_3) emissions in the 1990s, but rising emissions in the 2000s raise concerns for sustainability. From 11 108 tonnes in 1995, ammonia emissions fell to 9 058 tonnes in 1999 due to a decrease in the number of livestock (EMÜ, 2008). Ammonia emissions then increased over the last decade (to 13 042 tonnes in 2014), while the number of cows decreased and milk production increased (FAOSTAT, 2016).

As in most countries, agriculture is the primary source of ammonia emissions in Estonia (accounting for 94% in 2012-13). Livestock breeding contributes 69%, and the use of N fertilisers contributes 25%. Other major sources of pollution include road transport, the production of fertilisers and the burning of firewood in households (EEA, 2014b).

Greenhouse Gas emissions

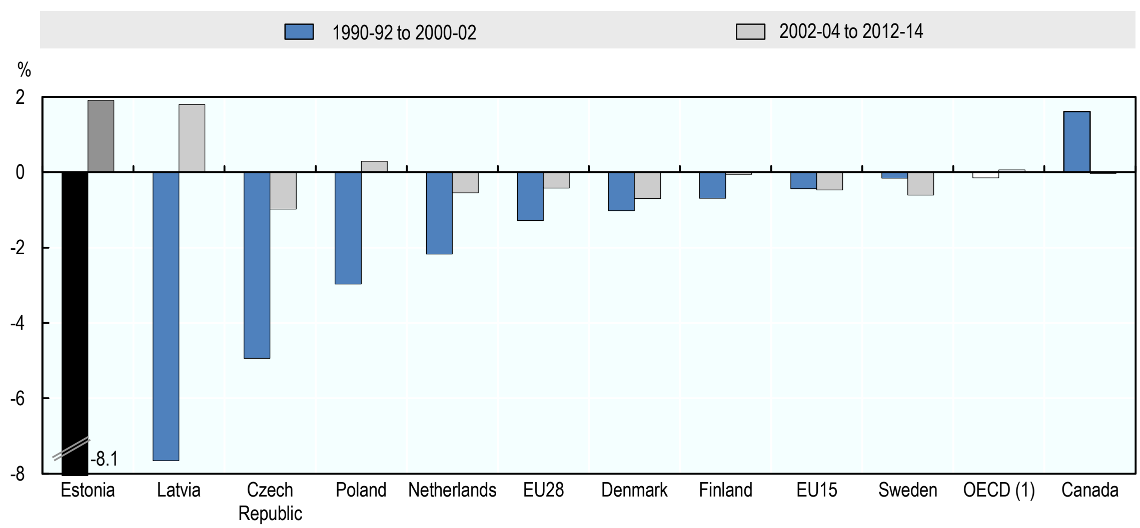
Following the energy sector (which produced 89% of total Greenhouse Gas (GHG) emissions in 2014), Estonia's agricultural sector is the second largest contributor (producing 1 318 thousand tonnes of CO_2 equivalent, or 6% of total GHG emissions (Estonian NIR, 2015). The main agricultural GHG emissions in Estonia are CH_4 emissions from enteric fermentation of domestic livestock and direct N_2O emissions from agricultural soils. N_2O emissions from manure management systems, indirect N_2O emissions from agricultural soils, and CO_2 emissions from liming and urea application to agricultural soils also contribute.

Agricultural GHG emissions declined significantly in the 1990s as the sector contracted, but have experienced positive growth over the last decade as the sector expanded and input use increased. From 1990-92 to 2000-02, agricultural GHG emissions in CO_2 eq. decreased in Estonia on average 8% annually – much faster than in other selected countries (Figure 2.20). However, from 2002-04 to 2012-14, agricultural emissions increased by an annual average of nearly 2%. During the same period, Latvia experienced a similar increase, but emissions experienced close to zero or negative growth in all other selected countries.

Notwithstanding, low-income EU member states are not obliged (for now) to reduce emissions in sectors excluded from the emissions trading system such as agriculture. Rather, by 2020, the increase of emissions in such countries should not exceed 11% of 2005 emissions (Government Office, 2014; MRA, 2013c; MoE, 2016).

As agriculture intensifies due to continued EU support, agricultural GHG emissions are likely to increase without further measures. As crop production expands, it is important to ensure that crops are not cultivated on peat and eroded soils, which could enhance GHG emissions (since the intensification of agriculture and the expansion of agricultural land will induce the application of mineral fertilisers, which, in turn, will result in increased direct and indirect nitrous oxide (N_2O) emissions from agricultural lands) (MoE, 2013a). Moreover, more efficient livestock practices will be needed to increase production while meeting EU targets for reductions in GHG emissions.

Figure 2.20. Average annual percentage change of GHG emissions from agriculture, 1990-92 to 2000-02 and 2002-04 to 2012-14



Countries are ranked according to (1990-92 to 2000-02) levels.
1. OECD total, excluding Chile, Israel and Mexico.

Source: UNFCCC (2016), http://unfccc.int/ghg_data/items/4133.php.

StatLink http://dx.doi.org/10.1787/888933654047

Climate change

Over the past 50 years, the growing season in Estonia has become considerably longer. From 1965 to 2013, the overall vegetation period (t>5°C) and the active growing season (t>10°C) in Estonia increased by an average of three weeks — primarily due to the earlier occurrence of the last spring frost. This shift was the largest in South-Eastern Estonia, and less pronounced in North-Eastern Estonia (ETKI, 2015). This shift has contributed to the expansion of permanent grasslands and favoured the cultivation of winter crops.

Several shifts in **climate conditions** in the coming decades may further affect the Estonian agricultural sector (ETKI, 2015). Compared to the reference period 1971-2000, the air temperature in Estonia is projected to increase 2.0°C (RCP4.5 scenario) to 2.6°C (RCP8.5 scenario) during the period 2041-70 and 2.7°C to 4.3°C during the period 2071-2100. According to RCP4.5 (RCP8.5), average annual precipitation is also projected to rise by 10% (14%) in the period 2041-70 and 16% (19%) in the period 2071-2100. Moreover, extreme precipitation (more than 30 mm per day) is expected to increase, though the probability of occurrence is very low in every season except summer. RCP4.5 and RCP8.5 scenarios also project a significant decrease in snow cover by the end of the century. Furthermore, average wind speed is expected to increase (in the range from 3-18%) in winter and partly also in spring, triggering an increase in the number of cyclones moving from the Atlantic to Estonia (Estonian National Climate Change Adaptation Strategy and Implementation Plan).

Shifts in Estonia's **water** supply may also affect the agricultural sector. Sea-level rise may increase the risk of flooding in coastal areas (with valuable semi-natural coastal meadows (habitats) and grazed and managed pastures, which have historically adapted to flooding) and the destruction of port and harbour structures. Several valuable natural ecosystems may also be threatened, encompassing both marine and mainland ecosystems. Inland water may also be affected, as climate change may induce significant changes in the hydrological cycle. It is possible that the four main hydrological periods will be replaced by two, which means a fundamental change in the hydrological regime. As a consequence, the levels of inland water bodies may become lower than at present and more evenly distributed (in addition to spring floods, also autumn floods), potentially affecting land use. Compared to the baseline, climate change will have a favourable effect on river management in connection with the convergence of the seasonal distribution of run-offs. However, it may induce significant changes in the hydrological regime of near-groundwater layer because freshet infiltration into groundwater may increase by 20% to 40% due to the shortening and warming of the winter period. Owing to climate change, the ratio of the total groundwater recharge to surface runoff is projected to increase from 30% to 40% (EEA, 2014b; MoE, 2013b, MoE 2016; EMÜ, 2015). These hydrological changes could affect land use, its productivity and resilience to water related events.

Such changes in Estonia's environment and climatic conditions are expected to generate both positive and negative impacts for crop and livestock production. Taking into consideration the latitude of Estonia, the positive effects of climate change for **grasslands** will probably dominate at first. In particular, the increase in temperature and in the volume of precipitation will benefit grassland productivity (a rise in the average annual temperature by 1°C may improve the dry matter harvest of perennial forage crops by as much as 0.2 t/ha). The growing period will be lengthened and a higher number of cuttings will be available from grasslands (three times instead of the two in the last few years). In addition, the development and growth of grasses may accelerate and the suitable time for harvest may shift to an earlier period. This will ensure better fodder for livestock in summer and winter.

The estimated rise in temperature may also benefit **crop production**. In particular, it may enable Estonia to grow new, heat-loving crops and/or crops with longer growing cycles (ETKI, 2015). In the vegetation period, more heat than is necessary for the growth and development of plants will accumulate. The development of arable crops will quicken and the vegetation period will shorten (the optimal sowing period will shift forward by 4-11 days on average, and in order to achieve the maximum harvest the entire vegetation period should be lengthened by 10-30 days on average). This will increase the efficiency of arable land and will disperse the workload of agricultural producers. The lengthened vegetation period will additionally allow for the growing of new plant species and varieties in Estonia.

Several **potential risk factors** for the agricultural sector may also be exacerbated by climate change. In particular, grazed grasslands will be more sensitive than mown meadows to droughts brought about by climate warming. Yields may also be reduced by an increase in the frequency of extraordinary meteorological phenomena (droughts, excessive moisture, flooding etc.).[9] One of the greatest threats of climate change to Estonia would be the accelerated sea-level rise brought about by thermal expansion and the melting of glaciers, ice sheet and ice cap, which could trigger flooding along the coastline and extensive low-lying coastal areas of Estonia (MoE, 2013b). Lastly, the spread of plant diseases, plant pests and infectious animal diseases may increase with climate change.

2.8. Summary

- Estonia, situated on the coast of the Baltic Sea, is the northernmost of the Baltic countries, and the smallest in terms of surface area. Characterised by abundant land and water resources, the agricultural sector has expanded in the last two decades, although its contribution to a growing economy remains small.

- Estonia's **utilised agricultural area** (UAA) has fluctuated in recent decades, primarily due to policy shifts. After accession to the EU, agricultural land that was abandoned during the transition was reclaimed to qualify for CAP financing.
- The **type of agricultural land** in Estonia is predominantly — and increasingly — arable land. The area of agricultural land not used for agricultural production but maintained in good agricultural and environmental conditions (GAEC) has increased as well in recent years.
- Estonia's area for **organic production** has significantly increased. Driven by EU support to organic farming over the last decade, Estonia's land area under organic production has increased nearly four times. Organic production now constitutes 18% of UAA in 2015. However, part of organic production is sold to conventional processors.
- Significant restructuring has occurred in recent decades, resulting in a **dualistic structure** with large technically-efficient, more input intensive and innovative farms, as well as very small farms. This divergence can be seen both in terms of the distribution of UAA as well as livestock production. Similar to many other countries, the structure of Estonia's food processing sector is also dualistic.
- Estonia's **agricultural output** growth has been rapid since the EU accession. Agricultural output is dominated by milk production, but cereals and oilseeds production is increasing at a faster rate. Meat production has also increased over the last two decades, though production levels have suffered in the last couple of years due to African Swine Fever (ASF).
- While Estonian exports are growing, the country has a large **trade** deficit of agricultural and food products due to high imports of processed foods. Estonia's imports of agro-food products are mainly for household consumption, while the country exports a larger share of agro-food products for industrial use, suggesting the food processing industry is not as developed as primary production.
- The small size of Estonia's food processing companies and low labour productivity limit total factor productivity (TFP) growth and competitiveness.
- **Agricultural TFP** has increased strongly since 2000, following declines in the two previous decades. While low labour productivity has constrained productivity growth, capital improvements in the 2000s have benefited Estonia's agricultural sector. Policies to stimulate investment have facilitated the introduction of modern technology and rapid growth in knowledge.
- Growth in agricultural TFP and production volume has paralleled changes in the use of **natural resources** in Estonia over the last decade. In particular, agricultural land area increased, but at a slower rate than production volume and TFP growth. Direct on-farm energy consumption also increased. Furthermore, ammonia emissions increased at a higher rate than all other comparator countries. Moreover, eutrophication due to nutrient loads from diffuse and point sources threatens sustainable management of agricultural and water resources in certain regions. Furthermore, Estonia's phosphorus deficit increased — a growing concern for soil conditions. At the same time, a decoupling has occurred between TFP growth and Estonia's nitrogen balance and water use — both positive signs for the sustainability of the sector.
- Over the past 50 years, the growing season has become considerably longer in Estonia, contributing to the expansion of permanent grasslands and favouring the cultivation of winter crops. **Climate change** projections suggest that several shifts in the coming decades may further affect the Estonian agricultural sector, benefiting both grasslands and crop production. However, potential risk factors include an increase in the frequency of extreme meteorological phenomena (droughts, excessive moisture, flooding) and the spread of plant diseases, plant pests and infectious animal diseases.

Notes

1. The mid-point farm size applied to crop farms is the hectare-weighted median, which corresponds to a farm size that separates the farm size distribution into two parts: 50% of the total area of the national farmland operated by the crop farms of a larger size and the other 50% by the crop farms of smaller size than the hectare-weighted median.
2. The mid-point statistics used to measure the distribution of dairy farm size is the livestock unit-weighted median.
3. Excluding subsides on products and other subsidies on production.
4. While total beef production has declined, the quality of meat has changed. While in the 1990s beef was produced as a by-product of milk production (from culled cows and young bulls), after the EU accession, the number of beef cattle has increased significantly, from 9 400 in 2004 to 66 238 in 2016 (Vaan, 2016).
5. During the 1990s, the number of persons employed in agriculture, forestry and hunting decreased by 76%, from 161 400 in 1990 to 39 200 in 2000. This was the result of the transition from collective and state farms to private farms. Since 2000, farm employment has declined by 36% to 25 000 in 2016 as investments into modern equipment and technologies have increased labour productivity. At the same time, the number of small farms has decreased markedly since 2001.
6. The labour productivity indicators of food industry (value added at factor costs per employed person) and farms (net value added per Annual Work Unit, AWU) are not directly comparable, but here it assumed that they are acceptable proxies for the current comparison.
7. Statistics show a decline in water abstraction between 2002-04 and 2012-14 because data for 2002-04 include fish farming and data for 2012-14 do not.
8. Due to a change in methodology, data for earlier years is not available.
9. Higher temperatures have a particularly adverse effect on the yield of cereals and rapeseed. Rapeseed is particularly sensitive to high temperatures during seed development. Higher temperatures are often combined with drought, which further enhances the yield loss. The yields of winter cereals can also be affected by temperature fluctuations in autumn and winter, both excessively warm and excessively cold winters may act upon the yield. Long and warm autumns impair cold hardening in sowings. The scenarios for a typical winter in case of climate warming foresee more frequent changes between warm and cold periods during the winter, whereas alternations between cold and thaw and close to zero temperatures when it freezes at night and thaws during the daytime, increase, which significantly impairs wintering and increases the risk of frost damage. Data from national comparative trials and long-term complex experiments conducted at Kuusiku suggest that high temperatures during heading and booting, drought or excess water before and after sowing and drought before booting reduces the yields of spring cereals (barley, oats, wheat) (ETKI, 2015).

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Annex 2.A1. Background tables

Table 2.A1.1. Structure of agricultural holdings in selected countries, 2013

		Farm size group, ha								
		0 ha	<2	2-4.9	5-9.9	10-19.9	20-29.9	30-49.9	50-99.9	≥100
Czech Republic	Holdings	1.1	10.3	7.2	18.8	17.6	9.0	9.0	9.4	17.6
	UAA	0.0	0.1	0.2	1.0	1.8	1.6	2.6	4.9	87.8
Denmark	Holdings	3.7	0.8	2.2	20.0	17.7	10.2	11.2	13.9	20.3
	UAA	0.0	0.0	0.1	2.1	3.8	3.7	6.4	14.8	69.0
Estonia	**Holdings**	**2.2**	**9.2**	**21.6**	**20.7**	**17.4**	**7.3**	**6.2**	**6.0**	**9.3**
	UAA	**0.0**	**0.3**	**1.4**	**3.0**	**5.0**	**3.6**	**4.8**	**8.4**	**73.5**
Latvia	Holdings	1.3	21.6	19.7	19.7	19.3	6.5	5.1	3.3	3.5
	UAA	0.0	0.8	2.9	6.2	11.7	6.9	8.5	10.0	53.1
Lithuania	Holdings	0.0	14.1	39.1	22.4	11.7	3.8	3.2	3.0	2.7
	UAA	0.0	1.3	7.5	9.4	9.8	5.5	7.5	12.4	46.6
Netherlands	Holdings	2.5	10.3	14.6	13.9	14.9	10.2	16.3	13.8	3.5
	UAA	0.0	0.4	1.8	3.7	7.9	9.3	23.3	33.6	20.0
Poland	Holdings	0.5	22.8	31.1	21.6	14.6	4.3	2.8	1.4	0.8
	UAA	0.0	3.0	10.0	15.1	20.0	10.4	10.6	9.7	21.1
Finland	Holdings	0.3	1.6	3.5	11.3	20.2	15.1	20.1	19.4	8.5
	UAA	0.0	0.0	0.3	2.0	7.2	8.9	18.7	32.1	30.9
Sweden	Holdings	0.9	1.1	9.5	23.5	20.3	9.9	10.8	12.2	12.0
	UAA	0.0	0.0	0.9	3.7	6.4	5.4	9.3	19.1	55.2

UAA: Utilised Agricultural Area.

Source: Eurostat (2017), [ef_kvaareg], http://ec.europa.eu/eurostat/data/database.

Table 2.A1.2. Structure of the food processing industry in selected countries, 2015

Share of enterprises and turnover of various size classes in the total food industry, and average turnover per size class

		Size group, number of employees				
		0-9 persons	10-19 persons	20-49 persons	50-249 persons	≥250 persons
Czech Republic	Enterprises, %	82.3	6.5	6.0	4.3	0.9
	Turnover, %	3.6	3.3	9.7	43.1	40.3
	Turnover per enterprise, EUR million	0.1	0.7	2.4	14.8	69.0
Denmark	Enterprises, %	57.3	21.7	10.6	8.4	2.1
	Turnover, %	2.4	2.4	6.0	23.1	66.2
	Turnover per enterprise, EUR million	0.7	1.9	9.5	46.6	542.8
Estonia	**Enterprises, %**	**66.5**	**10.9**	**10.9**	**10.0**	**1.8**
	Turnover, %	**4.2**	**4.1**	**10.1**	**51.1**	**30.5**
	Turnover per enterprise, EUR million	**0.2**	**1.1**	**2.6**	**14.4**	**47.3**
Latvia	Enterprises, %	69.7	9.0	10.3	9.2	1.7
	Turnover, %	3.3	2.7	12.2	49.2	32.6
	Turnover per enterprise, EUR million	0.1	0.5	1.7	7.9	28.2
Lithuania	Enterprises, %	71.7	9.8	8.9	7.5	2.1
	Turnover, %	1.4	1.9	7.4	25.3	64.0
	Turnover per enterprise, EUR million	0.0	0.4	1.9	7.6	68.7
Netherlands	Enterprises, %	77.6	9.5	6.3	5.5	1.1
	Turnover, %	3.1	2.5	7.1	32.9	54.4
	Turnover per enterprise, EUR million	0.5	3.0	13.1	70.4	558.1
Poland	Enterprises, %	70.7	9.8	9.8	7.8	1.9
	Turnover, %	4.9	2.9	7.5	28.9	55.7
	Turnover per enterprise, EUR million	0.2	1.0	2.6	12.8	102.0
Finland	Enterprises, %	76.0	9.2	8.6	5.2	1.0
	Turnover, %	3.7	3.3	10.0	26.6	56.3
	Turnover per enterprise, EUR million	0.3	2.0	6.5	28.8	305.4
Sweden[1]	Enterprises, %	81.7	8.2	6.1	3.3	0.8
	Turnover, %	5.4	4.4	9.1	32.8	48.2
	Turnover per enterprise, EUR million	0.3	2.4	6.6	45.1	281.8

1. 2014.

Source: Eurostat (2017), [sbs_sc_sca_r2], NACE Rev2, C10, http://ec.europa.eu/eurostat/data/database (accessed in October 2017).

Table 2.A1.3. Developments of environmental indicators for agriculture in selected countries, 2002-04 to 2012-14

Average annual percent change 2002-04 to 2012-14, or nearest available period

	Total factor productivity	Agricultural production volume	Agricultural land area	Nitrogen balance	Phosphorus balance	Direct on-farm energy consumption	Water use	Ammonia emissions
	Index (1992=100)	Index (2004-06 =100)	thousand hectares	kg per hectare	kg per hectare	thousand tonnes of oil equivalent	million m^3	thousand tonnes
	2002-04 to 2011-13	2002-04 to 2012-14	2002-04 to 2012-14	2004-06 to 2011-13	2004-06 to 2011-13	2002-04 to 2012-14	1999-2001 to 2009-11	2002-04 to 2012-14
Canada	1.74	1.91	-0.33	1.87	-15.69	5.72	..	-0.03
Czech Republic	..	-0.45	-0.11	1.43	..	0.40	11.26	-1.52
Denmark	2.11	0.32	-0.14	-3.62	-6.79	-0.72	3.39	-2.19
Estonia	**3.44**	**3.08**	**2.34**	**-0.99**	**-4.46**	**0.72**	**-19.37**	**1.99**
Finland	1.66	-0.16	0.11	-1.44	-7.68	-0.19	..	-0.09
Latvia	2.62	3.08	1.50	6.06	2.64	2.38	-1.08	1.09
Netherlands	2.73	1.35	-0.52	-3.53	-15.89	-0.43	8.56	-2.34
Poland	1.34	0.77	-1.29	0.95	-5.28	-1.87	0.87	-0.17
EU28	0.40	15.06	-0.72	0.72	-1.11	-0.19	0.69	-100.00
OECD	1.43	2.37	-3.62	-0.99	-1.07	-1.44	-1.26	0.32

..: Not available.

Source: OECD (2017), Agri-environmental Indicators, www.oecd.org/tad/sustainable-agriculture/agri-environmentalindicators.htm; USDA (2016), Economic Research Service Agricultural Productivity Database for Total Factor Productivity, www.ers.usda.gov/data-oducts/international-agricultural-productivity.aspx.

Table 2.A1.4. Some farm sustainability indicators in Estonia, by farm type and size class, 2015

	Farm size group, ha				
Farm type	0-<40	40-<100	100-<400	> 400	Total
Field crops					
Use of fertilisers, EUR/ha of UAA	54	65	111	155	125
Use of crop protection, EUR/ha of UAA	15	20	43	50	43
Wheat yield, kg/ha	3 181	3 918	4 440	5 235	4 795
Ratio of wheat yield to costs of fertilisers and crop protection, kg/EUR	45.9	46.0	28.8	25.6	28.6
Assets, EUR/ha	3 739	1 505	1 688	1 814	1 841
Liabilities/assets, %	9.6	15.3	28.7	38.4	30.2
Farm net income, EUR	6 905	9 429	27 631	43 680	16 750
Farm income per unpaid farm labour, EUR/AWU	12 722	11 925	33 279	125 323	25 222
Milk					
Use of fertilisers, EUR/ha of UAA	4	4	31	77	60
Use of crop protection, EUR/ha of UAA	1	1	8	21	16
Livestock density, LU/ha of UAA	0.70	0.53	0.63	0.54	0.56
Wheat yield, kg/ha	3 180	3 752	4 672	5 165	5 056
Ratio of wheat yield to costs of fertilisers and crop protection, kg/EUR	637.8	885.0	118.5	52.7	66.3
Milk yield, kg/cow	7 400	7 200	7 571	9 007	8 511
Assets, EUR/ha	4 503	2 910	2 762	2 897	2 952
Liabilities/assets, %	33.8	29.4	32.9	44.8	40.9
Farm net income, EUR	764	5 653	-3 391	-19 511	946
Farm income per unpaid farm labour, EUR/AWU	712	4 870	-4 046	-154 040	-995
Other grazing livestock					
Livestock density, LU/ha of UAA	0.39	0.37	0.33	0.39	0.36
Milk yield, kg/cow	4 867	5 599	5 958	5 201	5 516
Assets, EUR/ha	2 206	1 525	1 277	1 123	1 431
Liabilities/assets, %	1.4	13.2	33.6	21.8	19.7
Farm net income, EUR	2 758	8 693	7 987	20 947	5 917
Farm income per unpaid farm labour, EUR/AWU	2 906	8 449	7 367	25 962	5 958
Mixed					
Use of fertilisers, EUR/ha of UAA	3	21	54	141	90
Use of crop protection, EUR/ha of UAA	1	7	17	46	29
Livestock density, LU/ha of UAA	0.17	0.22	0.21	0.37	0.28
Wheat yield, kg/ha	2 191	3 097	3 710	5 241	4 673
Ratio of wheat yield to costs of fertilisers and crop protection, kg/EUR	587.0	113.4	51.8	28.0	39.4
Milk yield, kg/cow	3 203	5 257	6 541	8 754	8 205
Assets, EUR/ha	4 127	1 827	1 676	2 617	2 461
Liabilities/assets, %	2.2	14.6	32.9	42.2	30.6
Farm net income, EUR	5 301	3 157	27 322	1 668	7 294
Farm income per unpaid farm labour, EUR/AWU	6 557	3 450	26 641	4 762	8 770

UAA: Utilised Agricultural Area; AWU: Annual Work Unit; LU Livestock Unit.
Source: FADN (2016), www.maainfo.ee/standardtulemused/.

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