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# Abbreviations and acronyms

AB Agricultural Board

AIN Agricultural Innovation Network

AIS Agricultural innovation system

ARC Estonian Agricultural Research Centre

ARIB Estonian Agricultural Registers and Information Board

AWU Annual work unit

BAT Best Available Technology

BE Bank of Estonia

CAP Common Agricultural Policy

CC Competence centre

CMEF Common Monitoring and Evaluation Framework

CMO Common Market Organization of the CAP

Digital Agenda 2020 Estonian information society strategy Digital Agenda 2020

EAFRD European Agriculture Rural Development Fund

EAGF European Agricultural Guarantee Fund.

EB Environmental Board

EC European Commission

ECRI Estonian Crop Research Institute

EDF Estonian Development Fund

EE Enterprise Estonia

EEIC Estonian Environment Agency

EERC Estonian Environmental Research Centre

EFM Environmentally Friendly Management

EIA Environmental Impact Assessment

EIC Environmental Investment Centre

EIP European Innovation Partnership

EIPTTC Estonian Intellectual Property and Technology Transfer Centre

EMU Estonian University of Life Sciences

EPO Estonian Patent Office

ERA European Research Area

ERC Estonian Research Council

ERDF European Regional Development Fund

ERDP Estonian Rural Development Plan

Estonia 2020 National Reform Programme "Estonia 2020"

EU European Union

Europe 2020 Europe 2020 – Europe’s growth strategy

GAEC Good agricultural and environmental conditions

GCI Global Competitiveness Index

GDP Gross Domestic Product

GHG Greenhouse Gases

Horizon 2020 EU Framework Programme for Research and Innovation

ICT Information and communication technologies

IP Intellectual property

IPPI Intellectual Property Protection Index

IPR Intellectual property rights

K Potassium

Knowledge-based Estonia The Estonian Research, Development, and Innovation Strategy 2014-2020, "Knowledge-based Estonia"

LU Livestock unit

MEAC Ministry of Economic Affairs and Communication

MER Ministry of Education and Research

MOE Ministry of the Environment

MOI Ministry of the Interior

MRA Ministry of Rural Affairs

N Nitrogen

NREAP National Renewable Energy Action Plan 2020

NRN Estonian National Rural Network

NVZ Nitrate Vulnerable Zones

P Phosphorus

PCT Patent Co-operation Treaty

PGR OECD Public Governance Review

PPP Public-Private Partnerships

PVPI Plant Variety Protection Index

R&D Research and development

RDC Estonian Research and Development Council

RDF Rural Development Foundation

RDI Research, development and innovation

RERC Rural Economy Research Centre

SAPS Single Area Payment Scheme

SEA Strategic Environmental Assessment

SME Small- and medium-sized enterprises

STEM Science, technology, engineering and math education

SE21 Estonian National Strategy on Sustainable Development "Sustainable Estonia 21” (until 2030)

TFP Total Factor Productivity

TMR Total mixed ration feeding system

TUT Tallinn University of Technology

UAA Utilized Agicultural Area

UPOV International Union for the Protection of New Varieties of Plants

UT University of Tartu

VCS Voluntary coupled support

VFB Veterinary and Food Board

WB World Bank

WEF World Economic Forum

WGI Worldwide Governance Indicators

YFS Young farmers’ scheme

# Overall assessment and recommendations

**Food and agriculture in the overall economy**

*Land*

1. In 2014, Estonia had 0.74 ha of agricultural and 0.49 ha of arable land per inhabitant. **In 2012, the figure for arable land per capita in Estonia was 0.17 ha (57.7%) and 0.21 ha (77.5%) higher compared to respectively the average of the OECD countries and the EU28**.
2. **Utilised agrigultural area (UAA) decreased during the transition period, and has been increasing after the EU accession.** From 2004-15, area of arable land increased by 28.9% to 669,665 ha. Area of agricultural land not used for agricultural production but maintained in good agricultural and environmental conditions (GAEC) increased by 469.6% to 125,053 ha. Area of permanent grassland decreased by 18.6% to 192,295 ha. Organic agricultural land increased by 271.2% to 170,797 ha. (Eurostat; WBG, 2015; SE, 2016)

*Water*

1. Estonia has sufficient freshwater reserves. In the last decade, increasingly fewer pollutants have reached the water environment and atmosphere each year; air pollution has also decreased. During the period from 1998-2000 to 2010-12, the water consumption in Estonian agriculture decreased on average by 16.0% annually. Agriculturue’s share in water withdrawal is low in Estonia, as the area of irrigated agricultural land is very small in Estonia (0.04% of agricultural land).
2. **Drainage is more important than irrigation in Estonia.** It is estimated, that without drainage, about 2/3 of the land for agricultural production would suffer from waterlogging. In 1995, about 732,400 ha (almost 85% of the cultivated land) were drained, of which 89%, were equipped with subsurface drainage systems. (AQUASTAT, 2016) Most of the drainage systems are over thirty years old and need reconstruction. In 2005, 26% of the draining systems were in a poor condition. The EU subsidies paid out between 2004-13 allowed to reconstruct about 15%, and renovate about 25% of the drainage systems in need of repair on agricultural land. Support for the reconstruction and renewal of land drainage systems is continued in 2014-20.

*Economy*

1. In Estonia, the share of agriculture, forestry and fishery in value added was highest among the selected countries. In 2015, the GDP per capita at current prices was about 15,600 euros; the total added value amounted to 17.7 billion euros, of which 3.5% was generated in agriculture, forestry and fishery (2.0% in crop and animal production, hunting and related service activities), 26.7% in industry and construction (1.9% in manufacture of food products, beverages and tobacco products) and 69.7% in services. Only in Poland and OECD area, agriculture comprised larger share in employment than in Estonia.

*Trade*

1. Estonian economy is oriented to foreign markets, and depends on external demand. Therefore, competitive manufacturing industry and services are very important. In 2014, in Estonia, trade as a percentage of GDP (71%) was two times higher than the OECD average, and larger than in the Netherlands, Latvia, Poland, Denmark, Sweden, Finland and Canada. The share of agriculture in trade in Estonia was lower compared to Latvia and the Netherlands, but higher compared to other selected countries and the OECD average. After the EU accession, the share of agricultural and food products in exports and imports has increased, and the trade deficit of agricultural and food products has declined. Live animals, animal and vegetable products, animal and vegetable fats and prepared food products constituted 9.8% of the total value of exported goods, and 10.7% of the total value of imports.
2. In 2015, the balance of trade of agricultural and food products (HS chapters 01-23) was -222.9 euros. The trade surplus was largest in cases of cereals (124.2 million euros) and dairy products (83.3 million euros). Also, the trade balance of live animals, Fish, preparations of meat and fish, animal or vegetal fats and oils and vegetable plaiting materials were positive. While Estonia was net exporter of live animals, and preparations of meat and fish, Estonia was net importer of meat (-42.9 million euros), fruits (-75.1 million euros), vegetables (-33.0 million euros), and preparations of vegetables and fruits (-46.4 million euros). The fact that Estonia is net exporter of cereals, and net importer of products of milling industry, and preparations of cereals, flour, starch or milk; and net exporter of live animals and net importer of meat, suggests that **the capacity and competitiveness of food manufacturing industry in export markets has not developed as quickly as the agricultural output**.
3. In 2015, 93.1% (based on value) the agricultural and food products imported to Estonia, were imported from the EU28 countries. 72.5% (based on value) of the agricultural and food exports from Estonia were exported to the EU28 countries. The neighbouring countries Latvia, Lithuania, Finland, Sweden and Russian Federation are the main trade partners in agricultural and food products. However, after imposing import ban in August 2014, trade with Russian Federation has markedly declined, causing difficulties especially in dairy sector.

*Farm structure*

1. Resulting from the reforms in the beginning of transition, the number of agricultural holdings increased from 1,154 in 1989 to 55,748 in 2001. Since 2001, the number of agricultural holdings has been decreasing. In the 2000-s, farm exists were mainly driven by the age of the farm operators (retirement), farm size with exists more probable in case of small farms, lack of successors interested in farming, and off-farm jobs in case of younger farm operators (Viira, 2014). In 2013, there were 19,186 agricultural holdings. However, the speed of reduction in number of agricultural holdings has slowed down in recent years. The number of agricultural holdings has declined mainly on the account of smaller farms (<20 ha). The number of holdings has increased only in size groups of 50-<100 ha and ≥100 ha.
2. The structure of agricultural holdings in Estonia is dualistic. In 2013, 78.0% of holdings (<30 ha) managed 13.2% of UAA. At the same time, 3.5% of agricultural holdings (≥300 ha) managed more than half (53.2%) of the UAA. According to the OECD, in 2010, the mid-point farm size in crop farms was 275.9 ha, being 5th largest after Canada, USA, Latvia and Germany. Mid-point farm size of dairy farms was 363 LU, being 2nd largest after the USA (Bokusheva and Kimura, 2016).
3. Intensity of fertilizers and crop protection usage is higher in larger farms, as well as the average yield of wheat. Average milk yield per cow is also larger in larger farms. There is a slight tendency towards higher livestock density in larger milk and other grazing livestock farms. 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.
4. Total farm income and farm income per unpaid farm (family) labour increases with farm size. In 2014, average annual gross wage in agriculture, forestry and fishing was 10,956 euros. If this is compared to farm income per unpaid farm (family) labour in different farm types and size groups, it is clear that many of the smallest farms are not viable if they do not have additional income sources from off-farm jobs or pensions.

*Agricultural output and productivity*

1. Since 2004, the contribution of cereals and oilseeds to agricultural output has increased. In 2003-05, milk comprised 31.4% of aggregated crop and animal output, cereals and oilseeds contributed 19.1% in total. In 2013-15, cereals and comprised 30.9% in total, and milk 27.5% of aggregated crop and animal output. From 1998-2015, (3-year moving average) cereal production has increased by 132.9%, meat production (in slaughter weight) by 38.7%, and milk production by 6.1%. However, due to improvements in milk quality and structural changes in dairy farming sector, milk collection has increased by 98.8%.
2. The average annual growth of the TFP (4.0%) from 1998-2000 to 2009-11 has been the fastest in Estonia.
3. Existence of large herds has through improved housing conditions and better dairy cattle feeding and management contributed to the rapid growth of milk yield in Estonia, and ensured a marked rise in the productivity of a large number of cows. From 1994-2013, among the selected countries, increase in average milk yield has been fastest in Estonia (132%, an average of 4.5% per year). 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 agri-environment.
4. Kimura and Sauer (2015) showed that the exit of inefficient farms is one of the most important drivers of productivity growth in the dairy farm sector. They found that in Estonia, herd size, higher milk yield and higher stocking rate had a positive impact on the productivity level. Labour input per cow and the intensity of purchased feed input had a negative correlation with productivity. Net investment had a negative impact on the TFP, but its productivity-enhancing effect is likely to be delayed. They concluded that **efficient management of labour and feed inputs could be one of the determinants of dairy farm productivity**. Thus, the main driver of productivity in Estonian dairy farm sector is the farm expansion and increasing milk yield by a few numbers of productive large farms.
5. Among the selected countries, the most significant increase in wheat yields was observed in the Baltic countries – in Estonia (97.5%, an average of 4.2% per year), Lithuania (85.8%, 3.7% per year) and Latvia (79.3%, 3.5% per year). Despite the marked increase, these countries have still relatively low yields compared to the Netherlands, Denmark, Sweden and Czech Republic. Rapid growth in wheat and cereal yields in general has contributed to an increase in total cereal production. In Estonia, from 2004-13, the area under cereal increased by 19.4%.
6. The productivity indicators for organic crop and animal production remain lower than those of conventional agriculture. As the average of 2012-14, the crop yields of organic wheat and conventional wheat amounted to 1.94 and 3.92 t/ha respectively. During the same period, the average annual milk yields per cow in organic and conventional holdings were 6,225 and 7,992 kg. (FADN, 2016)
7. African Swine Fever (ASF) was first diagnosed among the Estonian wild boar population in September 2014. In the summer of 2015, the first cases of ASF were confirmed in domestic pigs. This led to severe disease outbreak at pig farms in the summers of 2015 and 2016, which subsided by the end of September in both years. As compared to 2015/2016, around 53.0% of pig farmers closed down their businesses due to the spread and threat of ASF. The number of pigs kept on farms decreased by 11.2%, dropping from 328,000 in 2015 to 291,000 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).** Although the number of pigs has decreased, self-sufficiency in pork production is still maintained. The spread of ASF among Estonian feral and domestic pig herds has brought about additional investments into ensuring the compliance with biosafety and biosecurity regulations and led to major economic losses due to the restrictions imposed on trading and processing of pork.

*Structure and productivity of food industry*

1. In recent years, the number of food manufacturing enterprises has increased by 33.0% from 358 in 2010 to 476 in 2014. This increase is mainly due to increase of micro enterprises of 1-9 employees. From 2010-14, there has been slight increase in the number of enterprises in size classes 50-99, 100-249 and ≥250 employees. Like in the farming sector, the structure of food processing industry is dualistic. In 2013, in Estonia, there were 10 (2.2%) large (≥250 employees) enterprises, which total turnover comprised 30.5% of the aggregate turnover of food manufacturing industry. The proportion of large enterprises in Estonia is similar to other observed countries. Estonian large food manufacturing enterprises are smaller compared to their foreign competitors. Average turnover per enterprise of large Estonian food industry companies was 46.3 million euros in 2013. This figure was smaller only in Latvia, while the average turnover of large Danish and Dutch food industry enterprises exceeded the Estonian figure by 11.8 and 10.9 times, respectively.
2. Estonian food manufacturing industry is characterised by relatively low labour productivity. In 2013, value added at factor cost per employed person was 20,400 euros. Compared to Scandinavian countries, value added per employed person in Estonian food industry is approximately three times lower. The labour productivity gap between food industry and agriculture was one of the lowest in Estonia.
3. According to Jansik et al. (2014), the assortment of consumer dairy products (e.g. yoghurt) in a relatively small domestic market is wide, the series are small and there are frequents shifts to new flavours, which increase costs. They conclude that the average annual TFP growth in Estonian dairy processing industry was merely 0.3% in the period from 2000-11.
4. Viira et al. (2015) conclude that Estonian and Latvian dairy processing industry lack competitiveness in the Baltic raw milk market. While Estonian dairy industry processesed 74.8%, and Latvian dairy industry processed 72.0% of collected raw milk in 2014, Lithuanian dairy industry processed 118.7% of the volume of milk collected in Lithuania, i.e. raw milk is traded from Estonia and Latvia to Lithuania. One of the reasons for this could be lack of milk processing capacity in Estonian dairy industry. However, there are no official figures on the capacity utilization, and some experts state that there exists sufficient capacity, but probably it is outdated and inefficient.
5. In Estonian dairy industry, the productivity measured in quantity of processed milk per employee per year falls significantly behind the figures in the Netherlands, Germany and Ireland. Also, the production value per kg of processed milk is below the figures in the Netherlands, Finland and Germany. *In order to increase competitiveness,* **Estonian dairy industry needs to consolidate, invest into automation to achieve higher processed milk volume per employee, and to increase the value of production per kg of processed milk** *(Viira et al., 2015).*

*Production intensity and environmental pressure*

1. **In comparison with other Central and Eastern European countries, the intensity of agriculture is lower, the state of agro-ecosystem condition ranges from good to favourable** (based on EEA technical report No 6/2015). Still, there are regions that need further attention in order to manage agricultural and water resources in sustainable manner, in particular the Nitrate Vulnerable Area in Central and North-Eastern Estonia.
2. **Agricultural production in Estonia has concentrated into larger holdings and become more intensive compared to the end of the 1990-s.** The share of land used for intensive agricultural practices in 2004 was 7.6%; in 2012 8.7% and has increased to 9.6% in 2014 [KK81]. Livestock density is highest in farms that are specialised on granivores (pig and poultry production). However, such farmers have contracts with fieldcrops farms on manure spreading. In milk, other grazing livestock, and mixed farms, average livestock density increases with farm size.
3. The significantl increase in yields of field crops could be associated to increased application rates of mineral fertilizers and pesticides, which, however, remain lower as compared to Central- and Western-European countries. The number of agricultural animals has decreased. Thus, the application rate of organic fertilizers per fertilized ha and agricultural area, that is fertilized with organic fertilizers has decreased. In the period of 2004-12, the **N balance per ha of agricultural land has been positive with increasing trend and P balance has been increasingly negative**. Like most EU transition economies, Estonia revealed a strong growth in pesticide purchases over the 2000-s compared to 1990-s when in many cases the sales declined due to structural transformation and deteriorated terms of trade. From 2004-13, the total sales of pesticides in kg of active ingredients increased by 62.8%. **Pesticide use per ha of arable land and permanent crops was 0.6 kg/ha in Estonia as an average of 2005-09. That is considerably lower compared to the Netherlands (8.8 kg/ha) and Germany (2.3 kg/ha) and comparable to the usage in Denmark (1 kg/ha) and Finland (0.7 kg/ha)** (FAO 2013).
4. From 1998-2000 to 2008-10, direct on-farm energy consumption increased in Estonian farms on average 3.5% annually. Increased energy consumption can be result of the shift of production from labour intensive small farms to capital intensive larger farms.
5. According to the long-term (1988-2012) monitoring data, **the population of farmland birds has decreased. The number and status of birds is the highest in organic farming areas**.
6. As compared to 1990, the GHG emissions CO2 eq decreased by 45.7%. The main source of GHG emissions in Estonia is the energy sector, in 2013 this sector produced 87.6% of total GHG emissions, followed by agriculture (5.8%, totalling 1 254.05 Gg CO2 eq (Figure 2.28)), industry (4.9%) and waste products (1.7%). (Estonian NIR, 2015) **Emissions from the agricultural sector declined by 52.8% by 2013 compared to 1990, mostly due to the decrease in the livestock population and quantities of synthetic fertilizers and manure applied to agricultural fields.** During the period from 1998-2000 to 2008-10, the agricultural GHG emissions in CO2 eq decreased in Estonia on average 0.1% annually. The decrease of emissions in the OECD countries was 0.5% annually and in the EU15, 1.0% annually. Most of the ammonia released into the outside air is produced in agriculture: about 94% in 2013; livestock breeding accounts for 68.6%, and the use of N fertilizers is responsible for 25% of the ammonia released into the outside air in Estonia.

*Climate*

1. Since annual precipitation exceeds evaporation by two times, the climate is excessively damp. **From 1966-2010, the air temperature has risen faster than the global average.** It is not clear what proportion of the yield growth could be attributed to increased temperatures. It is likely that transition period in the 1990-s, increased investments into modern technologies after 2001, increased fertilizer and pesticides application after the EU accession in 2004, and new varieties have had stronger effects on crop yields than climate change. Warmer climate could be one factor influencing the growth in the sown area of forage maize, though.
2. It is difficult to assess the overall impact of climate change on agriculture in Estonia. It will mainly affect plant production and grasslands, whereas the effects may be both positive and negative. **The positive factors accompanying climate warming will probably dominate at first.** In 1965-2013, the overall vegetation period (t>5°C) as well as the active growing season (t>10°C) in Estonia increased by an average of three weeks, primarily due to the last spring frost occurring earlier. The shift was the biggest in South-Eastern Estonia, and less pronounced in North-Eastern Estonia. (ETI, 2015) **The increase in temperature and in the volume of precipitation will have a positive effect on grassland productivity.** The growing period will be lengthened and a higher number of cuttings will be available from grasslands. The earlier start of the vegetation period in spring contributes to the expansion of permanent grasslands and favours the cultivation of winter crops. **In addition, the estimated rise in temperature enables to grow new, heat-loving crops and/or crops with longer growing cycles, introduce more productive varieties,** for example, maize could become a widely grown crop. (ETI, 2015) The development of arable crops will quicken and the vegetation period will shorten. This will help use arable land more efficiently and disperse the workload of agricultural producers.
3. Despite the hazards (grazed grasslands will be more sensitive than mown meadows to climate warming that brings about drought periods; an increase in the frequency of extraordinary meteorological phenomena (droughts, excessive moisture, flooding etc.) may reduce yields; the spread of plant diseases, plant pests and infectious animal diseases; possible negative impact on the numbers of pollinators), Estonian agriculture will most likely be initially more productive and competitive as a result of climate change. (MoE, 2013b; EERC, 2016; EMU, 2015c)

**Economic stability and trust in institutions**

*Macroeconomic policy environment*

1. According to the OECD better life index, Estonia has made progress over the last decade in terms of improving the quality of life of its citizens. Estonia is performing above the OECD average in education and skills, environmental quality, and work-life balance, but below average in housing, jobs and earnings, subjective well-being, personal security, income and wealth, health status, and civic engagement.
2. **Due to continuing economic slowdown of the main trade partners, especially in Finland and Russia, the demand for Estonia’s goods and services has been low. Economic growth has been based on domestic consumption in recent years.** In addition, the wage income increase has supported consumption-led growth. In recent years, Estonia has witnessed stable price level. Prices of energy and food have been slightly declining. **The wage growth has exceeded nominal GDP growth rate. Therefore, the profitability of companies has declined, being one reason behind low investments by companies.** (MOF, 2015b) According to Bank of Estonia (BE), potential growth has been below expectations for long-term growth. BE emphasises that the major reason behind low growth rates are structural and these are not expected to change in the short-term. An example of such structural reason is the decline in exports to Russia. These exports are not likely to recover in short-term and redirecting these exports is difficult.
3. Estonia is known as a country with very low general government gross debt. The budgetary objectives are concerned with a general government structural surplus, strict fiscal policy and low level of government debt. The priorities in State Budget Strategy bring forward reduction of tax burden of labour and sustainable public finance. (MOF, 2015)
4. The World Economic Forum (WEF) Global Competitiveness Indicators (GCI) for 2015-16 rank Estonia the 30th within 140 countries. Estonia is considered an innovation driven economy. Notably well has Estonia performed in macroeconomic environment and labour market efficiency. **Even though the overall performance is very good, Estonia lacks from market size and business sophistication.** (WEF, 2015) Estonian companies rank 43rd in business sophistication and 29th in innovation. **In business sophistication, companies are not successful in having broad presence in the entire value chain; rather they are involved in individual steps of the value chain. Estonian companies are not very successful in using marketing to differentiate their products. The nature of competitive advantage is still in low-cost labour or natural resources. From innovation side, two things stand out. Very low availability of scientists and engineers for companies from one side (rank 73) and high level of government procurement of advanced technology products (rank 20).** Educational system in Estonia is one of the factors enhancing position in GCI rankings. Health and primary education (rank 22) and higher education and training (rank 20) support competitiveness and are ranked very high. Financial market development is considered very high (rank 23), especially the trustworthiness and confidence of the financial market. Both, goods and labour markets (ranks 22 and 15, respectively) are very efficient.
5. Estonian labour market is considered very flexible. According to the BE and TNS Emor survey, **the biggest barrier to recruitment is the shortage of qualified labour,** which was considered serious by 90% of the employers. **High labour taxes and high wages were also considered as obstacles to recruitment**. Only 36% of employers considered the costs of firing and hiring to be a barrier. (Soosaar, 2015)

*Governance and quality of public institutions*

1. **Both public and private institutions are considered very well developed and very reliable with combined ranking 25th.** According to the OECD Public Government Review (PGR) 2011, Estonia has developed all the necessary functions and apparatus of modern state and has become a model for small open economies. However, there are number of challenges starting with continuing economic slowdown, worsening demographical situation and growing regional disparities. Policy of openness has improved competitiveness, but has also made economy more vulnerable to external shocks. PGR 2011 points out that though the decision-making process in Estonia is very transparent, there are still some drawbacks in taking account stakeholders opinions. Survey by Praxis (2010) shows that biggest barriers to stakeholder participation with the state public administration are: too little preliminary information; too short timeframes for commenting; insufficient resources to divert to participating; and too time consuming participation. PGR concludes that Estonia has been successful in achieving stakeholder engagement goals in a relatively short period, but suggest that the **engagement activities should be developed further, in order to make stakeholder engagement as effective as possible**. (OECD 2011)

**Investment in the food and agriculture system**

*Regulatory environment for entrepreneurship*

1. Estonian Entrepreneurship Growth Strategy for 2014-20 sets two main objectives: 1) to increase productivity per employed person to 80% of the EU average; and 2) to raise the employment rate in the age group 20–64 to 76%. **In Estonia, legislators and governments have always set priority to policies that will improve the business environment in order to benefit from tax revenues and the jobs created by attracting foreign investors.** **Foreign investors and local entrepreneurs have equal rights and obligations.** There are no restrictions to start business in Estonia on the same basis as local entrepreneurs. (Estonian Chamber of Commerce and Industry)
2. The role of the state in business ownership in Estonia is negligible. In 2015, there were 25 solely state-owned companies. Only one of these companies is connected to agri-food sector, namely Vireen Ltd., which collects and recycles the perished farm animals and the animal by-products of the meat industry.
3. **Barriers to entrepreneurship indicator expresses that Estonia is among least restrictive countries.** Complexity of regulatory procedures and administrative burdens to start-ups have lower barriers than OECD average. Regulatory protection of incumbents is even better than in OECD top five countries.

*Regulations on natural resources*

1. Estonia had 802,959 ha of land (18.5% of terrestrial area) and 761,591 ha of water area (28% of the territorial sea and large lakes) under protection on 31.12.2015. The total share of protected area was 22% of territory. (EEIC 2015) The biggest share of the area under protection is in the counties of the West coast of Estonia, where the bulk of valuable habitats and areas of protected species in Estonia are located.
2. **The main principles that the environmental legal acts follow, are sustainable development, effective managing of natural resources, prevention and avoidance of environmental damages.**Regulations on natural resources and environment in Estonia are distributed between several legal acts. One reason for this divisibility was the increase in number of legislative acts during and after the EU accession, when fast adoption of EU regulations took place. The General Part of the Environmental Code Act came into force in 2014 (some parts in 2015), thus developing a unified base for specific acts in environmental law.
3. The environmental impact assessment is carried out in case of planning an activity with significant environmental impact. The strategic environmental assessment is carried out during the compilation of strategic planning documents (for instance the planning of land use, and development plans, including RDP). (EELC 2016) Impact assessments cover the following subjects: 1) environment; 2) society and demography; 3) economy; 4) security and international relations; 5) regional development; 6) administrative burden on institutions. Indicators collected in order to monitor the status of environment and resource use in Estonia are numerous and scattered. A unified and representative data network on natural resources and environment is expected to be ready in 2020. The quality of environmental impact assessment and the proficiency of experts needs to be harmonised. (MOE 2012 .. looduskaitse arengukava)
4. Certain agricultural activities (e.g. intensive livestock production) have an impact on various environmental elements (water, soil, air, waste, etc.). **In order to assess and reduce the impact of such actions, an integrated pollution prevention and control mechanism has been worked out.** According to this, enterprises over the threshold capacities (farms with >2000 pigs; >40 000 poultry; >400 dairy cows; etc.) need integrated environmental permits (RT I, 11.06.2013, 19). Permits include assessment on technologies, work operations (e.g. milking, feeding, waste management), sustainable usage of raw materials, chemicals, water, fuels etc. compared to reference technology. The conditions and restrictions in the permit must derive from the best available technology. Extention of the permit and potential changes depend on the results of regular inspections (at least once a year).
5. In Estonia, the environmental charges are divided into two: natural resource use fees and pollution fees that are designated to decrease the pollution from point sources. If the use of the environment exceeds the permitted amount or it takes place without permission, higher rates of pay will be implemented. (EELC 2016) Another mean for reducing the (diffuse) pollution from agricultural production is the obligation to follow environmental rules and good agricultural practice in order to be eligible for agricultural subsidies.
6. **Management and protection of soils in Estonia is a complex issue, since the properties of soil and water regime conditions vary significantly within small areas. About 46% of Estonian soils have a very good potential fertility and good environmental protection value.** Within the frames of agricultural policy and regulations, there are several obligations set to agricultural producers in order to conduct the sustainable usage of soil and substances used for improving soil fertility and plant growth. Field records with information of used plant nutrients have to be kept; determination of the acidity of soil, exchangeable P, K and organic carbon contents have to be monitored regularly by the recipients of agri-environmental subsidies. (EEIC 2013)
7. The results of the 2011 soil fertility and organic matter survey show that the agricultural technology used by organic farmers cannot maintain the potassium (K) content in the soil. **The possibilities the organic producers have to offset the K balance are relatively limited, but it is essential to find ways for the sustainable use of soils, either through the application of organic fertilizers or making changes in crop rotations.** Changes in the soil fertility indicators of EFM and SAPS producers indicate that in the past five years more and more attention has been paid to achieving the nutrient balance through a variety of agro-technological methods (crop rotation, fertilization). (ARC, 2011) Starting from 2015, the support for soil protection was evolved in order to compensate the sustainable usage of eroded and peaty soils on the fields that are not covered with other area payments under RDP support.
8. **Due to low population density and moderate agricultural intensity, the ecological status of Estonian surface water bodies has been among the best in Europe.** About 60% of the surface water bodies were in at least good overall status in 2014, nearly 60% of the surface water bodies being in at least good ecological status. (Statistics Estonia 2016)
9. **The regulations of Estonian Water Act on usage of organic fertilisers became more restrictive during 2014-16.** The amount of N given with organic fertilisers is restricted to 170 kg per every fertilised ha per year. The amount of P given with organic fertilisers can be up to 25 kg/ha on the average of five consecutive years. The application of organic fertilisers on the soil surface is prohibited in the case of slope of the land more than 10%. On the fields that are not covered with plants, organic fertilisers have to be mixed into soil within 48 hours (within 24 hours starting from 2021). Fertilisation of natural grasslands is prohibited, except for the manure left by grazing animals. Animal barns for more than 10 LU (more than 5 LU from 2023) are obliged to have a manure storage for solid and/or liquid manure depending on the manure type. Storage space must be sufficient for storing manure during eight months. Producers who have less than 10 LU, can store their solid manure temporarily on watertight ground near barn, protected from rainfall. The period of application of mineral and organic fertilisers is regulated based on weather and soil conditions. Fertilisation is not allowed during the period from 1 December to 20 March. During the period from 1-30 November, the application of organic fertilisers also on the fields with plant cover is allowed only in the case of incorporating into soil within 48 hours. A person engaged in agriculture must keep a field book, which entries must, inter alia, include the following information for each field: amounts of fertilizers used, including that of solid and liquid manure, their N and P content, time of use and names and amounts of the meliorants (soil amendments) used; the beginning and end date of the manure stockpiling, the date the manure from the stock is outloaded, and the location of the manure stack on the map of the Land Parcel Identification System.
10. In 2003, the government decree of forming regional Nitrate Vulnerable Zone (NVZ) in Pandivere and Adavere-Põltsamaa region was given. The area (3250 km2, i.e. 7.2% of territory of Estonia) was determined based on ground and surface water vulnerability (due to geological characteristics) and intensity of agricultural production in the region. The cultivation value of soils in the NVZ (50-55 points) is higher than the average cultivation value of arable land in Estonia (that is 43 points at 100-point scale). As a result of good quality soils, the average share of agricultural land is 40% in the region, that is 2 times higher than Estonian average [ENR 2016] Proportion of intensive agriculture in the area is between 13-15.4% (NVZ statistika), compared to the average proportion of 7.6% in Estonia in 2014 [KK81].
11. The restrictions and duties of NVZ are corrected in every fourth year based on monitoring data. The groundwater nitrate levels in the Pandivere and Adavere regions have grown steadily, and due to high nitrate levels, the water in some wells has become undrinkable. Therefore, it can be said that the existing requirements are not sufficient. Decision process of changing restrictions and widening the surface of the zone is currently running in 2016. (MOE 2016…põllumajandus ja veekaitse) Agricultural production in this region is restricted in the aspect of fertilisation and land use (RT I, 06.01.2016, 14)
12. Since agriculture gives a large share of the nutrient load in Estonia (approximately 50% of N and 1/3 of P load), **toughened regulations of manure handling and application technologies as well as restricted application rates are directed to decrease the nutrient load from organic fertilisers**. Usage of mineral fertilisers is considered to be less important factor, since the relatively higher fertiliser prices compared to agricultural producer prices limit the usage of mineral fertilisers. In Water Act, the requirement for meeting the plants’ need of nutrients with mineral fertilisers is stated. (RT I, 06.01.2016, 14). The efficiency of mineral N usage has improved during 2004-12 (ENR 2016). Experts foresee that the increasing proportion of complex mineral fertilisers used in larger farms should enhance the utilisation of N by plants and thus decrease nitrate leaching (ENR 2016).
13. **As a result of subsidy-supported investments into manure storages and other farm technologies, as well as the establishment of integrated environmental permit system, the risk of point source pollution from farms has decreased**. On the other hand, the results of inventories have revealed shortcomings of silage storages, as well as waste water handling, especially in farms with older technological systems (ENR 2016).
14. **The development of EFM subsidy schemes, organic subsidy scheme, etc. have increased the overall environmental awareness of farmers and spread of good management practices.** The ARC survey in 2014 revealed that 77% of farmers applying for the RDP 2nd pillar subsidies followed all of the Codes of Good Agricultural Practise, compared to 57% of farmers who were getting only SAPS payments. Correspondingly 11% and 19% of the farmers followed the Codes partly (ENR 2016). **Agricultural producers have to fulfil “Good Agricultural Practices” and environmental regulations as a pre-requisite of receiving direct payments, thus the incentives to follow the regulations are high.** Still the ongoing educating of producers is necessary in order to eliminate the mistakes because of lack of knowledge.

*Trade and investment policy*

1. Level of protection in Estonian foreign stems from the EU common tariffs. Compared to capital goods and industrial goods, the simple average of most favoured nation tariff rates applied on agricultural goods are higher. EU tariffs on capital goods and intermediate goods are on average higher than simple average of all OECD countries, but tariffs for agricultural goods are on average lower compared to the OECD average.

*Finance policy*

1. According to WEF GCI, Estonia ranks higher than OECD average in financial market developments. The mean aggregated results for Estonia are a bit higher than the OECD average and significantly higher than the EU28 average. The lowest rating was given to the availability of loans and venture capital, but ranking was still higher than the OECD average. The only component, which scored lower than the OECD average, was financing though local equity market. The main sources of financing for the Estonian entrepreneurs have been banks. The entrepreneurs are not aware of the various possibilities for attracting equity capital, and so far, there are still virtually no opportunities for equity exposures. Estonian companies are relatively small and therefore comparatively little public information is available, which does not make the companies particularly attractive to external investors. Also, companies do not want to relinquish control over their businesses.
2. **Due to the extensive investments made by Estonian agricultural producers, the loan balance (in current prices) granted by credit institutions to the companies operating in agriculture, forestry and fishing has doubled over the past ten years**, constituting 5.4% of the total loan balance at of the end of April 2016 (in 2005 the figure was 3.8%). From 2010-14, the interest rate on loans in the agricultural sector was comparable to or even lower than the average interest rate across all sectors, but since 2015, higher interest rates on loans to the agricultural sector could be observed. **In connection with a decline in agricultural producer prices, the financial solvency of agricultural enterprises has remained low and, therefore, banks have become more conservative**, and all credit seekers do not get a positive response. In other words, credit institutions have imposed a higher risk margin on enterprises operating in the agricultural sector. **At the beginning of 2016, the average amount of payment default was the highest in the agricultural sector**. Bank representatives are closely monitoring the cash flows in the companies and, if necessary, a grace period is allowed. At the beginning of 2016, nearly a quarter of the loan portfolios in the dairy sector held by Swedbank had been granted a period of grace. In comparison, it should be stated that in 2013 grace periods were not practically applied for.
3. **It is possible for the rural enterprises in Estonia to use a variety of financial services with the mediation of the Rural Development Foundation (RDF).** RDF is a foundation founded by the state which aims to support and stimulate entrepreneurship in rural areas by providing the rural enterprises and farms opportunities for accessing financial capital (guarantees, direct loans, loans to credit institutions). RDF issues guarantees for the debt obligations of entrepreneurs (loan, leasing, etc.) with an aim to ensure a better access to credit facilities by increasing the creditworthiness of the borrower (which can be reduced by insufficient or illiquid collateral (underlying assets), high risk start-ups, changing the area of activity, absence of earlier borrowing experience or unclear reliability).
4. Starting from 2016, the RDF under a contract with the MRA will issue loans (growth loans and long-term investment loan) and collaterals to the entrepreneurs in agriculture, food industry and in rural and collateral. The RDF funds are allocated from the measures of the Estonian RDP 2014-20 and their total volume is 36 million euros15. The measure is expected to improve the access of the food sector and the rural entrepreneurs to capital and allow the necessary investments for which financing is otherwise difficult to find at the market.
5. The RDF and the Government of the Republic of Estonia are considering launching a commercial organisation in cooperation with the farmers to provide alternative financial services to the agricultural and fishery producers, which would contribute to the diversification of the funding possibilities for businesses. One of the alternative financial services under consideration is property sale and leaseback that is directed at producers.

*Tax policy*

1. **In Estonia, the objective of the government’s tax policy has been a partial shifting of the tax burden from income taxation to the taxation of consumption, use of natural resources and the pollution of the environment. However, at the same time the government tries to keep the tax system simple and transparent with as few exceptions as possible.** As an exception, a reduced rate of excise duty on beer is applied to small producers, and in agriculture and commercial fishing, discount rates are used on specially marked diesel fuel.
2. Farms and agri-food firms are generally subject to the same taxation regime as the rest of the economy. There are differences in the taxation of the return on sales of self-produced unprocessed agricultural products, of land used in agricultural production, and reduced excise duty rates for agricultural producers and small producers of beer. In the period of taxation, a sole proprietor (SP) can additionally deduct up to 2,877 euros from the income received from the disposal of self-produced unprocessed agricultural products minus the documented business expenses. In 2015, the supplementary deduction for SP amounted to 2.5 million euros (MOF as of 26.5.2016), constituting 0.3% of the value of agricultural output.
3. From 2000, an exceptional corporate income tax system has been imposed on companies in Estonia regardless of their field of operation: **companies are subject to corporate income tax only in respect of dividends, or on other payments made to capital holders from equity. All undistributed corporate profits are tax-exempt.**
4. Among other things, the Global Competitiveness Report 2015-16 highlights the present tax rates in force and the complexity of tax regulation as the problematic factors affecting business. The study shows that the **total tax rate as a percentage of profit in Estonia is 49.3% (110th place among 140 countries).** As to the effect of taxation on the incentives to invest, Estonia was ranked 15th and the effect of taxation on incentives to work 47th among the 140 countries.
5. Pursuant to the Fiscal Marking of Liquid Fuel Act of 1 January 2015, fiscal marking applies to diesel fuel that is intended to be used:

* in machinery, tractors and non-road mobile machinery used for agricultural purposes and in drying facilities that are used to dry agricultural produce;
* in commercial fishing.

1. **In 2015, the value of fiscal benefits used in agricultural machinery, tractors and mobile machinery, and agricultural drying kilns amounted to 35 million euros (3.8% of the total value of agricultural output). (MOF as of 26.5.2016)**
2. In 2014, there were two EU member states, Estonia and Germany, which lacked a tax policy directly stimulating innovation (A Study ...). **In Estonia, still no tax rules providing incentives to innovation have been introduced. Currently, both the Estonian tax and national support system, favour capital investments.** The present Estonian tax system stimulates the volumes of external funding rather than the investor’s initial decision to make the investment and does not contribute to attracting higher value-added investments (innovation, knowledge-based and higher-productivity investments) to Estonia. Investments into intellectual property and creating ‘smart jobs' still calls for greater attention from the tax policy point of view. (Made in Estonia 3.0) Studies have suggested that income tax rate for R&D employees should be reduced. However, the suggestions were put into practice. Teder (2014) has pointed out that as the aim is to enhance knowledge-based Estonian economy, **tax incentives could be applied for research intensive enterprises to ensure a net increase in salary to top researchers and top specialists**. The suggested tax incentives included reducing the personal income tax and the social tax.

**Capacity building and services for the food and agriculture system**

*Infrastructure and rural development policies*

1. **According to the WEF GCI, the quality of overall infrastructure in Estonia is quite similar to the average of OECD countries.** Total index of transport infrastructure in Estonia is lower than the OECD countries’ average. The port infrastructure is the best quality, being better than the OECD average, but the railroad and air transport infrastructure indices are very low. The low index given to air transport can be explained by the low number of connections to Europe and other continents, as well as the constantly varying destinations. The reason for the low index for rail transport is also the scarcity of international connections and the low speed of passenger train traffic. (MEAC, 2013c)
2. A well-developed infrastructure in rural areas helps to compensate for the distance between rural areas and major attraction centres. Entrepreneurs consider the availability (with sufficient capacity) and fault tolerance of the energy, availability and quality (speed) of communications infrastructure, water quality and the state of the roads the most essential factors of the business environment. **The condition of infrastructure in rural areas of Estonia varies a lot. Out of the technical infrastructure elements, the entrepreneurs rank the condition of local roads as the worst. According to local authorities, the biggest problem is the poor technical quality of electricity supply network and the excessive pricing of grid connection and electricity capacity upgrading.** The state of the roads and the availability of adequate electric power supply was rated the worst by the entrepreneurs in South Estonia.
3. **Technological adoption in Estonia is similar to that of the OECD average.** Scores for mobile telephone subscriptions are very high and for internet use relatively high (80% of individuals use internet, in high income OECD countries the figure is 81%). The indices for fixed telephone lines and the quality of electricity supply are lower than the OECD average. **In 2005, the share of enterprises using computers and broadband Internet access in the agricultural sector was slightly lower, as compared to other sectors, but by 2016 these differences became non-existent.**
4. Since 2010, Estonia has been rapidly developing the basic broadband infrastructure (passive optical network) with the EU support with a view that around 98% of residences and businesses are within 1.5 km of the nearest connection point (MEAC, 2013a). Unfortunately, the development of basic broadband infrastructure has not significantly increased the number of users. The problem lies in making high-speed broadband access to the Internet network accessible to the end uses. Communications operators do not have economic interest in developing it in remote areas.
5. **Thanks to IT development, farmers and food processors have a very good access to information concerning market developments, technical possibilities and the weather.** E.g., one of the services on offer is field based weather forecast, which enables the farmers to plan their fieldwork according to the weather conditions and thus increase their operational efficiency (Vitalfields). Farmers also receive a lot of information (on the equipment, technology, etc.) from vendors and distributors. Information on market developments can be obtained from seminars and panels organised by producer organizations.
6. **Estonia stands out for the use of electronic ID, which makes it possible to make administration practically paper free, fast and flexible.** The development of the e-government, especially the elaboration of e-services for the public sector and their application by the citizens and enterprises has so far been the strength of the national ICT policy. In this respect, it should be noted that there are problems with modern Internet connection in sparsely populated rural areas, which means that there are also problems with the accessibility of e-services for both the residents and entrepreneurs. Digital Agenda 2020 aims to tackle this market failure.

*Labour market policy*

1. **The Estonian labour market stands out primarily by the flexibility of wage determination and a high proportion of women in the labour market and from the social point of view, it would be important to deal with the retaining and attracting talents. The relation between labour costs and productivity is good, but as the pressure on salary increase has been high, and the wages have gone up faster than productivity**.
2. The unemployed registered with the Unemployment Insurance Fund can participate in the training sessions. It is also possible to get a business start-up subsidy, which is financial aid (in 2016 up to 4,474 euros) aimed at providing motivation and support in starting a business as a start-up or a sole proprietor. (The Unemployment Insurance Fund ...)
3. Estonia has initiated a number of projects to solve the problems. For example, to attract talent the Estonian Chamber of Commerce and Industry launched the “Bringing talent home” project in 2010, which endeavours to bring together employers in Estonia with talented young people who have gone abroad to study or work (Bringing talent home 2016). Since it is difficult to find skilled workforce in in rural areas, a citizen initiative “Come to live in the countryside” was launched. The initiative has a website that allows to find jobs and housing in the countryside, as well as find opportunities for entrepreneurship.
4. Although the movement of labour is easier within the EAA, migrant workers from the third countries, are subject to strict rules and regulations. As a rule, third country nationals must seek a residence permit to enter the labour market in Estonia. An annual immigration quota that should not exceed 0.1% of the permanent population of Estonia per annum is set for aliens immigrating to Estonia (Aliens Act § 113). For this purpose, permission must be granted by the Estonian Unemployment Insurance Fund and the wage criterion fulfilled. This means that the employer is required to pay remuneration amounting to 1.24 times the average annual wage published by Statistics Estonia (Recruiting from abroad ...). As the wage coefficient for third-country workers coming to work in Estonia will be reduced from 1.24 to 1.0, the situation with seasonal workers in agriculture is expected to relax.
5. Since it is not easy to enter the labour market in Estonia, it is also reflected in the relevant official statistics. The share of immigrant population employed in agriculture is only 1-2% (Statistics Estonia). **Horticultural producers, who wish to alleviate the terms for recruiting temporary seasonal workers from the third countries, have been most active in fighting against the present migration conditions, which are currently forcing the employers to pay migrant workers in Estonia a higher salary that is paid the seasonal workers, for example, in Finland.** Due to its specifics, horticulture is a labour intensive branch of agriculture. Since the emigration of people from Estonia continues and the state policy does not favour the recruitment of temporary work force from the third countries, horticultural producers are due to the shortage of workforce struggling with the harvest. For example in strawberry cultivation alone, it would be possible in the peak season to offer a temporary assignment to an additional 200 temporary employees (Gardening people ... 2014).

*Education and skills policy*

1. **Estonia has been historically characterized by a high attainment of higher education**. In 2014, 38% of people aged 25-64 had higher education, whereas the OECD average was 32%. Estonia has a long traditions of higher education and the proportion of older generation with tertiary education is relatively high: 36% of 55-64-year-olds have received higher education. However, the OECD average is 25%.
2. Estonian education system is comprised of two subsystems: 1) education devised on the basis of the objectives and levels of education; 2) educational institutions as organisations responsible for implementing the objectives of education. A system-level assessment of the education system is carried out yearly by the Ministry of Education and Research.
3. In Estonia, governance of the education system is shared between central and local authorities, and schools have a high level of autonomy for resource allocation. The state sets national standards and establishes principles of education funding, supervision and quality assessment. Schools in Estonia have a level of autonomy above the OECD average, including the capacity to make decisions on the curriculum and to hire and dismiss teaching staff.
4. **The results of the PISA survey show that the basic level schoolchildren are also among the best performers as compared to other countries in the world and in Europe**
5. PIAAC 2012 study results show that Estonian adults perform above average levels in numeracy and functional literacy, surpassing the average result of the surveyed countries. The problem solving skills among older people are significantly lower. PIACC results show that often computer literacy is required in some occupations in Estonia, but the computer skills of the employees do not meet the contemporary requirements and are limited to specific activities only. In this part the personnel at Estonian educational institutions stand out. Their problem-solving skills in technology-rich environments are almost the lowest, while the frequency of computer use at work is still among the average. The survey also revealed that a significant number of young people (up to 24 years of age), who have good computer and problem-solving skills and use computers in everyday life are currently holding such jobs where computer skills are not needed (mainly in hotel and catering services). Since 1989, considerable changes can be identified in the structure of employment: the share of skill-intensive positions has increased from 35% to 42.7% in 2014, and the trend towards more complex positions continues. **However, Estonian entrepreneurs and foreign investors consider the shortage of adequately trained personnel a key challenge in the local economic development.**
6. **Decrease in the number of students is characteristic of all educational levels**. Until 2010, the number of students participating in vocational education was relatively stable, but since the 2010/2011, the low birth rate of the second half of 1990-s has had a negative impact on this indicator and the trend is going to continue in the coming years. **In recent years, the average age of students in vocational education in Estonia has significantly increased. Similarly to the changes in the age structure of the students in vocational education, the number of adult students (over the age of 30) enrolling at the university has also increased. The number of admissions to higher education has decreased in the past years**, and this tendency has been in line with the change in the number of full-time secondary school graduates. **As the number of secondary school graduates in the coming years will continue to decline and the proportion of older people admitted to the first tier of higher education has remained at the same level, it is likely that the number of students is continuing to decline** (MER, 2016f).
7. **While the general trend in the number of students enrolled in vocational training in Estonia has been declining, the number of students engaged in such fields of study as agriculture and arts and humanities has been going up in the past five years.**
8. The employment rate in rural areas has grown year on year, from 53.7% in 2009 to 65.3% in 2015, but the problem lies in the lower level of education of the rural working age population, which considerably limits their competitiveness in the labour market.
9. According to the Innovation Union Scoreboard 2013 the number of new doctorate holders per 1 000 population in the age group of 25-34 in the EU is 1.5. The corresponding figure for Estonia is below the EU average (0.9). (MER, 2014c) **In increasing the number of doctoral graduates is a real challenge in Estonia.** The “Study of effectiveness of doctoral programmes in Estonia” (Eamets et al., 2014), points out that due to the demographic trends in Estonia and a decrease in the number of externally financed doctoral study places after the introduction of the requirement to pay support to all doctoral students, the number of applicants to doctoral studies may decrease in the coming 5-6 years. The analysis also revealed that the prospective career path is not an essential motivator for the PhD candidates. This is an indication of the fact that, **on the one hand the wages in the academic sector are not competitive on the labour market any more, and, on the other hand, the employers in the private sector do not attach any value to the doctoral degree**. **There are not enough large companies in Estonia that have the need and the opportunity to recruit PhD students and specialists with a PhD**. Only 1% of the adult respondents with higher education participating in the PIAAC study said that they would have required a doctoral degree to get the job, which is two times less than the total of the 24 PIAAC participant countries and, for example, five times less than in Finland.
10. Agricultural education is available in Estonia, both through higher and vocational education programmes. Four higher educational institutions and 14 vocational education establishments teach agricultural and food processing. There is only one higher educational institution specialising directly on agriculture (Estonian University of Life Sciences (EMU)) and two vocational education institutions (Järvamaa Vocational Training Centre and the Olustvere School of Service and Rural Economics).

**Agricultural Policy**

*The main policy framework*

1. Estonia is an EU member state since 2004. Therefore, the main agricultural policy framework is strongly related to the EU Common Agricultural Policy (CAP). Following the general structure of the CAP, the programmes and funding are laid out in two pillars. Pillar 1 includes common market organisation (CMO) that provides market support and direct payments. Pillar 2 includes rural development support which is implemented according to national Rural Development Plan (RDP).
2. Estonian agricultural producers witnessed increase in direct payments from 2004-12. From 2012 onwards the direct payments have decreased; in 2014-16, the main reason has been the government’s decision not to pay transitional national aid. In coming years the direct payments will increase. **From 2008 onwards the value of direct payments as a percentage of agricultural output (in current prices) has declined from 18.2% in 2008 to 11.6% in 2015.**
3. **For the period 2015-20, the National ceiling of direct payments in Estonia is 897.2 million euros** (Regulation (EU) No 1307/2013). Estonia decided to transfer 10.8% of the National ceiling to Pillar 2. Of the remaining Pillar 1 budget of 799.9 million Euros, 65.5% is allocated for flat rate basic payment (single area payment scheme) conditional on maintaining agricultural land in GAEC and 30.0% is allocated for mandatory greening payments; 4.1% is allocated for the voluntary coupled support (VCS), and 0.3% to young farmers’ scheme (YFS) (European Parliament, 2015; communication from MRA). Estonia is one of the EU member states that is allowed to pay transitional national aid in addition to the National ceiling that is financed from the European Agricultural Guarantee Fund (EAGF). However, in 2014-16, the Government decided not to utilise this opportunity. The new government that assumed office in November 2016, aims to pay transitional national aid in the maximum amount, starting from 2017 (Government, 2016b).
4. In 2015-16, VCS was paid to households that have ≤100 cows; for heards that have ≤25 suckler cows and heifers of up to 8 months of age; for ewes and sheeps in herds with 10-100 ewes or she goats that are at least 1 year old; for growing fruits and vegetables on at least 1 ha of land (MRA, 2015f; RT I, 22.04.2015, 30; RT I, 22.04.2016, 2). **For the period 2017-20, due to the difficult situation in the milk farming sector, MRA plans to increase the payment rate for households that have ≤100 cows, and introduce a payment for households that have 100<…≤400 cows.** According to the plan, VCS for suckler cows and heifers, and for ewes and sheep will be abolished (MRA, 2016k).
5. **The indicative budget of Estonian RDP in 2015-2020 is 992.8 million euros**, of which 36.8% is related to priority ‘4. Ecosystem management’, 28.6% of the budget is allocated to priority ‘2. Competitiveness’, 17.7% to priority ‘6. Social inclusion and local development’, 10.6% to priority ‘3. Food chain’, and 2.4% of the budget is related to priority ‘5. Resource efficiency and climate change’. 3.9% of the RDP budget is allocated for technical assistance, i.e. implementation of the RDP

*Evaluation of Agricultural policy measures*

1. During the programming period of Estonian RDP 2007-13, for the first time, an ongoing evaluation was carried out, that provided analyses and feedback on the implementation and results of the RDP. During the compilation of Estonian RDP 2014-20, an ex-ante evaluation was carried out. In parallel, a strategic environmental evaluation was done. Several recommendations of the strategic environmental evaluation were implemented in designing the measures of the RDP 2014-20. The results of ongoing evaluation were used as an input in the process of ex-ante evaluation.
2. **The results of various analysis and impact assessments were considered in developing the Estonian RDP 2014-20.** E.g. RDP 2014-20 includes sub-measures ‘Innovation clusters’ and ‘Long-term programmes of knowledge transfer’ where applicants should form a consortium consisting multiple partners from R&D institutions, agricultural producers, food processors, advisory system, vocational education institutions and other stakeholders. Also, the advisory system was reformed, and the role of the coordinating centre was given to Rural Development Foundation. Young farmers will be suppored from CAP pillars I and II to support generational change of agricultural producers. Budget of RDP 2014-20 measures that target food processing industry is larger compared to the RDP 2007-13.

*Domestic measures targeting specific issues*

1. In 2015, the payments based on variable input use amounted to 26.68 million euros (OECD, 2016b):

* **The main instrument related to variable input use is a fuel excise tax exemption for agricultural producers for using diesel fuel marked with fiscal marker in the machinery used in the process of agricultural production.** The exemption amounted to 26.0 million euros.
* Support for the replacement of agricultural producers amounted to 0.5 million euros.
* Private storage aid for pig meat amounted to 0.16 million euros.
* Three-year instalment of the milk quota super levy at 0% interest rate amounted to 0.17 million euros.
* Insurance subsidies amounted to 0.01 million euros.

1. Insurance support measure was introduced in 2008. The measure compensates partially (50-80%) insurance payments for agricultural crops, agricultural animals, poultry and bees to small and medium sized enterprises. Insurance for agricultural crops is not provided in Estonia. In 2015 and 2016, compensation was paid to pig farms whose herds were culled, and feed and equipment were destroyed due to the diagnosis of African swine fever. In 2015, the compensation amounted to 1.9 million euros (OECD, 2016b). The damage caused by wild animals and birds are compensated by the Environmental Board.
2. **Adoption of new technologies is supported through RDP measures 4. Investment in physical assets, and 6. Farm and business development.** **Innovation is also in the focus of RDP measure 9. Cooperation** that includes sub-measures: Innovation cluster; Short supply chains and development of local markets; Development of new products, practices, processes and technologies. These measures aim to support the cooperation of farms, food processing industry, R&D institutions and other actors in finding innovative solutions relevant for the whole agricultural and food sector or sub-sector, or individual enterprise or group of enterprises.
3. In the farming sector, structural adjustment is facilitated mainly via the RDP measure 6.1. Start aid for young farmers, the aim of which is to support new entrants and transfer of farm management to younger and well prepared managers.
4. The RDP includes a sub-measure targeted to financing a large projects, i.e. large-scale (with support 2-15 million euros) investment into processing facility. Only such applicants are eligible, in which producer cooperatives own majority of shares.
5. Until 2014, the most important agri-envionment schemes supporting sustainable agriculture in Estonia were environmentally friendly management (EFM) and organic production.
6. For agricultural producers it was difficult and expensive for to get credit in the 1990-s. Therefore, the 1990-s were characterised by lack of investments in the agricultural sector. Direct payments were first implemented in 1998, capital (credit) subsidies in the end of 1990-s. Therefore, to compensate for the „lost decade in agricultural investments“, **agricultural policy in Estonia has paid significant attention to supporting investments into modernisation of agricultural holdings**. EU pre-accession programme SAPARD was launched in 2001, also RDP-s 2004-2006, 2007-2013, 2014-2020 include significant amount of investment support to agicultural producers for modernisation of their technologies. **Investment grants, subsidies on products and other subsidies have significantly affected investments (gross and net capital formation) into agricultural holdings.** Agricultural production indices have significantly increased since the beginning of 2000-s, suggesting that the policy decisions and farm investments have markedly affected the production and (partial) productivity development.

**The agricultural innovation system**

*General innovation profile*

1. **In most of the categories of comparative performance of national science and innovation systems, Estonia is in the middle range of OECD values.** Estonia has strongest competences and capacity to innovate in R&D, entrepreneurship environment, international cooperation and young performers in science. Shortcomings are mainly related to low RDI performance in firms, which, in part is due to the relatively small size of Estonian companies. While the public R&D expenditure is relatively high, the index of publications in the top journals is relatively high, and the index of top 15 year-old performers in science is high, Estonia has problems with doctoral graduate rate in science and engineering, and top adult performers in technology problem solving. This indicates shortcomings in knowledge transfer from high level R&D groups to the education system.
2. The results of the Eurostat Community Innovation Survey give a good overview of innovation implementation in food industry. In the Estonian food industry, in the period 2010-12, half of the companies upgraded their equipment and machinery. External knowledge and R&D, as well as training for innovative activities were ordered less frequently. **Enterprises cooperate mainly with equipment, materials, components, and software vendors (nearly half of the cooperating companies), but significantly less with the public sector, consultants and commercial laboratories, universities and other institutions of higher education.**

*Actors, institutions and governance*

1. For a long time, Estonian innovation policy has been built on innovation systems approach. Supporting the economic sectors the state is specializing in forms an important part of the innovation system. As to investments into research and development (R&D) activities, focus is placed on promising areas of particular interest to the state guaranteeing high added value (Kalvet et al., 2010). The state has promoted information and communication technologies (ICT) the most by introducing a number of e-services (Romanainen et al., 2014).
2. **The strategic framework of the innovation policy is logical, but it lacks a comprehensive model. Estonian innovation policy is characterized by the abundance of strategic documents, action plans, policies, programmes and projects, which coherence is difficult to identify.** Substantive activities related to achieving the desired level of innovation call for development, including the horizontal implementation of the innovation policy in the country as a whole, risk management related to innovation introduction/purchase, cooperation between the different parties, including stakeholder involvement. Stakeholder involvement in the elaboration and implementation of innovation policy in Estonia has gained momentum, but today their involvement still lies in participation in the meetings with sectoral umbrella organizations, universities or Estonian Chamber of Commerce and Industry.
3. **National and sectoral development plans and strategies are related to the EU-wide strategies.** Two national horizontal strategies cover innovation, entrepreneurship and sustainable development concerns – the Estonian National Strategy on Sustainable Development “Sustainable Estonia 21”, and the National Reform Programme “Estonia 2020”. Most of the sectoral and sub-sectoral strategies are based on or related to two strategies – The Estonian Research and Development and Innovation Strategy 2014-2020 “Knowledge-based Estonia” and the Estonian Entrepreneurship Growth Strategy 2020. Three of the latter strategies are closely related to the pan-European growth strategy Europe 2020 contributing to achieving the strategic objectives set by the EU.
4. The innovation policy in Estonia employs the EU smart specialization concept, which focuses on stimulating the three smart specialisation growth areas (information and communication technology (ICT), which is linked to other economic areas, health technologies and services, and resource efficiency), where the development opportunities of the companies are above the average and commitment to R&D will allow them to gain a competitive advantage.
5. The main strategy document guiding the development of Estonia’s research, development and innovation (RDI) policy is Knowledge-based Estonia. It is the third consecutive strategic document in this area. The overall aim of the RDI development is to create favourable conditions for an increase in productivity and living standard, for good-quality education and culture, and for the longevity and development of Estonia (MER, 2014).
6. **Innovation policy in agriculture is in line with the general innovation policy in Estonia**, which is shaped by the state, and which leading promoters are MER and MEAC. As compared to the previous periods, the agricultural sector, as well as other sectors, has been more involved in the overall planning of the innovation system under the EU programming period 2014-20. Sectoral strategies must support the strategic objectives set in Sustainable Estonia 21 and Estonia 2020. The strategic objectives in the national horizontal strategies have been devised in cooperation with sectoral ministries, so that the sectoral policies and goals are reasoned and consistent with the objectives set. Therefore, **RDP for 2014-20 is regarded as one of the sectoral strategies contributing to general innovation system of Estonia**.
7. **Innovation is one of the priorities of the RDP 2014-20.** The goal is expressed as follows: “Effective manufacturer, processor, and advisor collaboration with scientists, and transfer of up to date knowledge.” Focus is on encouraging collaboration between the various parties (producers, consultants, academics) and on thereby improving the adoption of research results into practice.

*Public and private investment in innovation*

1. **MRA is responsible for planning, coordination and implementation of R&D activities in agricultural sector in order to support policymaking, knowledge transfer, training, and application of research**. MRA finances applied research, knowledge transfer and innovation in agriculture, food and fisheries sector through national programmes “Agricultural Applied Research and Development from 2015–2021”, “Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014–2020”, “National Programme for Plant Breeding from 2009–2019”; and through measures of ERDP 2014-2020 and European Maritime and Fisheries Fund’s operational programme (MRA, 2016d).
2. **The specific aims for agricultural research in Estonia are**: 1) Competent scientific support for designing and implementing CAP and fisheries policy; 2) Competent scientific support for the agriculture, food and fisheries sector; 3) Sustainability of scientific community; 4) State-of-the-art facilities and infrastructure; 5) Estonian researchers participation in international research cooperation; 6) Plant and animal breeding; plant genetic resources ex situ conservation and collection; 7) Effective knowledge transfer, incl. between R&D organisations and agricultural producers (MRA, 2016f).
3. Estonia has set the target to increase R&D investments to 3% of GDP in 2020 (Government Office, 2014). Estonia 2020 estimates that this would mean quadrupling of R&D spending compared to 2009 (Government Office, 2014). The target for 2015 was 2% of GDP. In 2014 the indicator decreased to 1.44% of GDP (Statistics Estonia, 2016). Therefore, it is likely that the target for 2020 will not be met.
4. **The growing concern in Estonian R&D system is extremely high share of project-based funding.** Estimates from 2014 indicate that around 80% of funding was project based (HTM 2014). Over 90% of research funding in all public universities was project based, while some R&D institutes are 100% project funded raising concerns for long-term strategic planning and sustainability of R&D institutions (Ukrainski et al., 2015b). On the basis of the suggestions from RDC, MER and governments coalition policy agreement there are plans for considerable change in the financing instruments, including for considerable increase of the share of baseline funding in order to achieve more stability in research funding (MER 2015d).
5. Innovation-related cooperation between the state, the universities and business enterprises has been more active in large-scale enterprises. **The most innovative companies in Estonia are the subsidiaries of foreign companies and foreign-owned companies. However, Estonia is dominated by low-tech small and medium-sized companies, whose need for research and development activities has so far been rather limited.** Corporate spending on research and development has increased the most in primary and resource-intensive production. Still, despite the almost threefold growth in the expenditures on research and development, the expenditures on agricultural research in Estonia have, however, been the lowest. **The majority of the investment in agriculture, forestry and fishery constitute the acquisition of machinery and equipment necessary for higher value-added production. Food production and forestry companies are far more innovative. In their case, expenditures on new product development have prevailed.**

*Knowledge flows*

1. Estonia is following the concept of the European Research Area (ERA) that was renewed in 2012. One of the priorities of the concept is to ensure open access to knowledge, optimal knowledge circulation and transfer through the application of digital ERA. Farmers are granted free access to the research information on the website of the Estonian Agricultural and Rural Advisory Service.
2. The number of Estonian agricultural patent applications is modest, both in the EPO and PCT calculations, an IPR system is at place in Estonia and, with reference to a stable political environment, has a positive effect on the country’s economic growth. This is confirmed by the change in the Intellectual Property Protection Index (IPPI) over time. In ten past years, the Estonian IPPI has increased, and is equivalent to the average of the OECD countries and slightly higher than the average of EU28 countries.
3. Competence centres are an important source of innovation, but funding leads them to frequently focus on international issues as opposed to topics that can benefit the domestic agriculture sector.
4. A number of different Estonia advisory services are operating in the counselling services market. Part of the research activities carried out through direct contacts between the companies and researchers. The Advisory Centre of RDF also provides co-ordinated and regulated counselling to farmers and rural entrepreneurs. But farmers are not satisfied with the current advisory system.
5. Depending on the financial possibilities, the farmers and food processors have self-financed their training, or received training from input salesmen, raw material suppliers or purchasing agents, whose activities are tied to their economic interests, or have received free training supported from the EU or national funds.

# 2. Overview of food and agriculture situation

## Food and agriculture in the overall economy

*The overall economic, social and environmental context in which the sector operates, and the natural resource base upon which it relies, are important drivers of sector performance. The structural characteristics of the sector affect its capacity to adapt to new challenges and opportunities. In the long-term, sector productivity and sustainability performance are determined by innovation, natural resources, climate change, and structural change – which in turn are influenced by a range of policies.*

### Estonia’s main economic and geographical characteristics, the share of agriculture in the economy, in the use of natural resources and in terms of pressures to the environment

1. 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 population and surface area. As of 1 January 2016, the population of Estonia was 1.312 million and the population density was 30.2 inhabitants per km2 of land. In 2015, 62.9% of the population lived in towns and cities and 37.1% in rural areas. The rate of urbanisation was relatively high already in the 1980-s (67.8% in 1989) and has not changed much over past three decades. In the last decade, population of suburban regions around major cities have increased. The territory of Estonia is 45,339 km2 (including transboundary water bodies, except the sea), of which, land surface area is 43,432 km2. Almost half of the mainland is covered with forests. Estonia stretches 350 km from East to West and 240 km from North to South. Tallinn, the capital of Estonia, is situated in North Estonia. Utilized agricultural area (UAA) constitutes 22%, settlements, roads and pipe-laying routes 7%, and the rest of the territory is covered with marshes, bogs and shrubs. Natural and artificial lakes take up 6% of the country’s territory.
2. In 2014, arable land constituted 66.5%, permanent grassland 20.3%, orchards 0.6% and land not used for agricultural production but maintained in good agricultural and environmental conditions (GAEC) 12.6% of the UAA (Figure 2.1 and Table 2.2). In 2015, the area under organic farming totalled 170.8 thousand ha (17.5% of UAA), of which arable crops constituted 21.3% and grassland 76.7% (Table 2.2). Irrigated area was 427 ha (0.04% of UAA).

**Figure 2.1. Utilised agricultural area (1000 ha) in Estonia in 2014**

Source: Statistics Estonia (2016)

1. In 2014, Estonia had 0.74 ha of agricultural and 0.49 ha of arable land per inhabitant. Compared to the average of the OECD countries[[1]](#footnote-2) in 2012, the figure for arable land per capita in Estonia was 0.17 ha (57.7%) higher, and compared to the EU28 average, 0.21 ha (77.5%) higher (Table 2.1). In Canada and Latvia the area of arable land per capita is larger than in Estonia. In Denmark and Finland, the area of arable land per capita is approximately the same as in Estonia, whereas the figure for Czech Republic and Poland is smaller. In case of the Netherlands the difference (0.41 ha) is especially big.

**Table 2.1. Contextual indicators**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | GDP | GDP  per capita | Population | Total land area | Agricultural land | Arable land per capita | Freshwater resources | Freshwater resources per capita |
|  | (USD billion) | PPP (USD) | (million) | (thousand km2) | (thousand ha) | (hectares) | (billion m3) | (m3) |
|  | (2014) | (2014) | (2014) | (2013) | (2013) | (2012) | (2013) | (2013) |
|  |  |  |  |  |  |  |  |  |
| **Estonia** | **26** | **26 902** | **1,3** | **42,4** | **966** | **0,47** | **13** | **9 643** |
| *(ranking)* | *(101)* | *(43)* | *(148)* | *(124)* | *(138)* | *(16)* | *(111)* | *(46)* |
| Latvia | 31 | 22 932 | 2,04 | 62 | 1 868 | 0,58 | 17 | 8 317 |
| Lithuania | 48 | 26 746 | 3,2 | 63 | 2 891 | 0,76 | 16 | 5 261 |
| Poland | 548 | 24 567 | 38 | 306 | 14 410 | 0,28 | 54 | 1 392 |
| Finland | 272 | 39 987 | 5,5 | 304 | 2 259 | 0,42 | 107 | 19 673 |
| Denmark | 342 | 44 889 | 5,6 | 42 | 2 609 | 0,43 | 6 | 1 069 |
| Netherlands | 879 | 47 635 | 17 | 34 | 1 848 | 0,06 | 11 | 655 |
| Czech Republic | 205 | 30 366 | 11 | 77 | 4 219 | 0,30 | 13 | 1 251 |
| Canada | 1 785 | 44 057 | 36 | 9 094 | 65 251 | 1,32 | 2 850 | 81 071 |
| EU28 | 18 500 | 36 237 | 508 | 4 238 | 186 356 | 0,26 | 1 505 | 4 740 |
| OECD | 48 480 | 38 854 | 1 265 | 34 341 | 1211 805 | 0,30 | 10 466 | 28 117 |

PPP: Purchasing Power Parity.

Source: OECD Statistics, FAOSTAT, and World Development Indicators 2015.

1. In the longer term, the land and water resources in Estonia are sufficient for contributing to the development of agriculture to meet the demand for agricultural products and food both in domestic and foreign markets. Freshwater resources in 2013 amounted to 12.7 million m3, whereas the figure per capita was 9,643 m3. Compared to the OECD average, the freshwater resources per capita in Estonia were 2.9 times smaller and compared to the EU28 average 2.0 times higher. In Czech Republic, Denmark, the Netherlands and Poland, freshwater resources per capita are smaller than in Estonia. The indicator for Latvia was almost the same (the difference is 14%). Freshwater resources per capita in Canada and Finland were respectively 8.4 and 2.0 times higher than in Estonia. (EEA, 2016, LB 2015, SE, 2016, AB, 2016, WBG, 2015)
2. Estonia belongs to the mixed-forest sub-region of the Atlantic continental region of the temperate zone. Lying between Finland and the Gulf of Riga, the weather in Estonia is typical for the boreal biogeographical region. Summers are moderately warm and winters moderately cold (the mean air temperature in July being 16-17 °C and in February between -2.5 and -7 °C). Since annual precipitation exceeds evaporation by approximately two times, the climate is excessively damp. In the second half of the 20th century (especially from 1966-2010), the air temperature has risen faster than the global average. While crop yields have increased, it is not clear what proportion of the yield growth could be attributed to increased temperatures. It is likely that transition period in the 1990-s, increased investments into modern technologies after 2001, increased fertilizer and pesticides application after the EU accession in 2004, and new varieties have had stronger effects on crop yields than climate change. However, from 2004-15, the sown area of forage maize has increased by 7.6 times from 1,115 to 8,494 ha, comprising 70.8% of sown area of annual forage crops, and 1.4% of that of field crops. Warmer climate could be one factor influencing the growth in the sown area of forage maize. One of the greatest threats of the global climate change to Estonia would be the accelerated sea-level rise brought about by thermal expansion and melting of glaciers, ice sheet and ice cap, which could affect the long coastline and extensive low-lying coastal areas of Estonia. (MOE, 2013b) Thus, the rise of sea-level could threaten valuable semi-natural habitats and extensive beef and sheep farming systems in Western-Estonia.

**Table 2.2. Changes in agricultural land, water use, and environmental indicators in Estonia, 1990-2014**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1990-92 average | 1998-2000 average | 2008-10 average | 2012-14 average | Annual % change over the period | | |
| 1990-92 to 1998-2000 | 1998-2000 to 2008-10 | 2008-10 to 2012-14 |
| **Land** | | | | | | | |
| Agricultural land (% of area) | 33,6 | 26,2 | 21,4 | 22,2 | -2,7 | -1,9 | 1,0 |
| *Agricultural land use (in %)* | | | | | | | |
| Share of arable land in agricultural land, % | 79,4’ | 85,5 | 66,0 | 65,6 | 1,0 | -2,3 | -0,1 |
| Share of permanent cropland in agricultural land, % | 0,9“ | 1,2 | 0,8 | 0,7 | 4,6 | -3,1 | -4,9 |
| Share of permanent pasture in agricultural land, % | 19,7’ | 13,4 | 33,2 | 33,7 | -4,0 | 14,8 | 0,4 |
| Protected terrestrial areas (% of land area) | 19,4’ | 20,6 | 21,9 | 22,7 | 0,8 | 0,6 | 1,0 |
| Organic area (% of agricultural land) | .. | 0,7\* | 11,0 | 15,7 | .. | 146,5 | 10,9 |
| **Water** | | | | | | | |
| Water use in agriculture, thousand m³ | 35491,0’ | 4756,0 | 4160,4 | 4793,4 | -10,8 | -1,3 | 3,8 |
| Share of agriculture in total water use, % | 1,4’ | 0,4 | 0,3 | 0,3 | -9,2 | -1,2 | 0,0 |
| Irrigated area, ha | .. | .. | 352 | 427,0\*\*\* | .. | .. | 5,3 |
| Irrigation water application rates, m3/ha | .. | .. | 11,8 | 11,2\*\*\* | .. | .. | -1,3 |
| **Air and climate change** | | | | | | | |
| Agricultural GHG emissions, 1 000 metric tons of CO2 equivalent | 2406,6 | 1107,7 | 1152,9 | 1249,9 | -6,7 | 0,4 | 2,1 |
| % of total national emissions | 9,1 | 8,2 | 9,6 | 6,4 | -1,3 | 1,7 | -8,3 |
| Ammonia emissions from agriculture, tons | 21297,6 | 9662,6 | 9695,4 | 10354,9†† | -6,8 | 0,0 | 1,7 |
| % of total NH3 emissions | 97,5“ | 94,6 | 92,6 | 94,9†† | -0,4 | -0,2 | 0,6 |
| **Livestock** | | | | | | | |
| LSU per ha of agricultural area | 0,5 | 0,3 | 0,3 | 0,3 | -5,5 | 1,2 | 0,5 |
| **Fertiliser and pesticide use** | | | | | | | |
| Quantity of mineral fertilizers per fertilized hectare, kg | 204,0“ | 82,7 | 128,7 | 132,3 | -7,4 | 5,6 | 0,7 |
| Quantity of organic fertilizers per fertilized hectare, tons | 59,0“ | 30,7 | 32,3 | 28,7 | -6,0 | 0,5 | -2,8 |
| Pesticide use on arable and permanent crop area, tonnes per 1 000 ha | 0,4 | 0,3 | 0,8 | 0,8 | -4,6 | 19,6 | -0,7 |
| Nitrogen balance per hectare, kg | .. | 36,3\*\* | 30,6 | 28,0† | .. | -1,6 | -2,1 |
| Phosphorous balance per hectare, kg | .. | -4,6\*\* | -5,6 | -6,2† | .. | 2,8 | 2,3 |
| **Energy** | | | | | | | |
| Energy use in agriculture and forestry (% of total energy use) | 12,7 | 2,7 | 3,3 | 4,1 | -9,9 | 2,2 | 6,5 |
| Bioenergy production (% of total renewable energy production) | 100,0 | 99,9 | 98,0††† | .. | 0,0 | -0,2 | .. |

‘average of 1991-1992; “data from 1992; \*average of 1999-2000; \*\*data from 2004; \*\*\*data from 2013; †data from 2012; ††average of 2012-2013; †††2008-2009 average

Source: Statistics Estonia (2016)

1. In 2015, the gross domestic product (GDP) per capita at current prices was about 15,600 euros; the total added value amounted to 17.7 billion euros, of which 3.5% was generated in agriculture, forestry and fishery (2.0% in crop and animal production, hunting and related service activities), 26.7% in industry and construction (1.9% in manufacture of food products, beverages and tobacco products) and 69.7% in services. In 2014, the GDP per capita in Estonia was 30.8% below the OECD average and 25.8% below the EU28 average. GDP per capita in Canada, the Czech Republic, Denmark, Finland, and the Netherlands was higher than in Estonia. Compared to Estonia, the GDP per capita was lower in Latvia and Poland. (OECD, 2016; SE, 2016) In Estonia, the share of agriculture, forestry and fishery in value added was highest among the selected countries in 2015 (3.5%). In Latvia and Lithuania, it was 3.3% (Eurostat [nama\_10\_a10]). From Figure 2.2 it appears that only in Poland and OECD area, agriculture comprised larger share in employment than in Estonia. Compared to Estonia, the contribution of agriculture to exports was higher in Poland, Denmark, the Netherlands and Canada; and the share of agriculture in imports exceeded the Estonian figure in Denmark and the Netherlands. In Estonia, agricultural land use in total land exceeded only the figures of Finland and Canada. Agriculturue’s share in water withdrawal is lowest in Estonia, as the area of irrigated agricultural land is very small in Estonia (0.04% of agricultural land) (Table 2.2).

**Figure 2.2. Share of agriculture in the economy in Estonia and the selected countries, 2014**

Source: OECD System of National Accounts, OECD Annual Labour Force Statistics, UN COMTRADE, FAO FAOSTAT, FAO AQUASTAT, 2015.

1. Over the last 20 years, in Estonia, agriculture’s share (includes forestry and fishery) in value added has declined from 5.7% in 1995 to 3.5% in 2015 (Table 2.3). Contribution of agriculture (including forestry and fishing) to value added was declining until 2009 when it reached 2.5%. After 2009, the share of agriculture in value added has remained between 3.5 and 4.0%. In 1995, 10.3% of employees worked in agriculture, forestry and fishing. By 2015, these activities comprised 3.9% of the employment. During the transition, the share of agricultural and food products in exports and imports declined. However, after the EU accession, the share of agricultural and food products in exports and imports has increased, and the trade deficit of agricultural and food products has declined. While in 2004, the trade deficit of agricultural and food products in the average of imports and expots was -4.5%, by 2015, the deficit decreased to -2.1%. UAA decreased in the transition period, and has been increasing after the EU accession. The share of agriculture in total water withdrawal has declined (Table 2.2).

**Table 2.3. Share of agriculture in the economy in Estonia, 1995-2015**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | 1995 | 2000 | 2005 | 2010 | 2015 |
| Share in value added at current prices, % | Agriculture, forestry and fishery | 5.7 | 4.8 | 3.5 | 3.2 | 3.5 |
| Proportion of the employed , % | 10.3 | 6.7 | 5 | 4.2 | 3.9 |
| Share of exports, % | HS sections I-V | 16.5 | 8.1 | 7.2 | 9.5 | 9.8 |
| Share of imports, % | 14.2 | 10.0 | 8.6 | 11.0 | 10.7 |
| Agricultural area, 1000 ha |  | 991 | 986 | 882 | 949 | 993.6 |

Source: SE (2016), Faostat (2016)

1. On the whole, the GDP growth in Estonia in 2000-14 was faster than the OECD average, as well as that of Canada, the Czech Republic, Denmark, Finland and the Netherlands (Figure 2.3). Estonia’s fast economic growth from 2000-07 was related to favourable external environment. In this period, Estonia’s integration with international supply chains deepened. That led to increasing external demand. Extensive investments, inflow of EU structural funds after the EU accession in 2004, foreign direct investments and loans, fast growth in construction and real estate sector and accompanying credit boom were the main factors of economic growth. Global economic crisis of 2008-09 hit Estonia severely. Unemployment increased, most notably in construction. Internal demand was hampered by decrease of investments and private consumption. At the time of the crisis, Estonia applied strict fiscal policy (MEAC & MOF, 2009; Purju, 2013; Reiljan, 2015).

**Figure 2.3. Real GDP growth in international comparison from 2000-14, 2000=100**

Source: OECD Economic Outlook No 96 - November 2014 - OLIS version and OECD System of National Accounts, 2015

1. Estonian economy is oriented to foreign markets, and depends on external demand. Therefore, competitive manufacturing industry and services are very important. In 2014, trade (the average of exports and imports) in Estonia as a percentage of GDP (71%) was two times higher than the OECD average, and larger than in the Netherlands, Latvia, Poland, Denmark, Sweden, Finland and Canada (Figure 2.4). Compared to the Czech Republic, the figure was about 8 percentage points lower. The share of agriculture in trade in Estonia was lower compared to Latvia and the Netherlands, but higher compared to Czech Republic, Poland, Denmark, Sweden, Finland, Canada and OECD average.

**Figure 2.4. Trade as a percentage of GDP in international comparison in 2014**

Source: UN COMTRADE 2015; OECD, 2015.

1. In 2015, the foreign trade balance of goods was negative (-1,457.6 million euros), while the foreign trade balance of services was positive (1,657.2 million euros). Out of the total of exported goods, worth 11.6 billion euros, machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and similar devices and their components accounted for 28.5%, wood and wood products; wood charcoal; cork and articles of cork; straw or other plaiting materials for 9.9%, mineral products for 9.4%, other manufactured products for 8.7% and metals and metal products for 7.3%. Live animals, animal and vegetable products, animal and vegetable fats and prepared food products constituted 9.8% of exported goods. Estonia imported goods worth of 13,1 billion euros, of which 28.3% were machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and similar equipment and parts, 10.8% mineral products, 9.3% of the vehicles, aircraft, vessels and other means of transport, 8.3% products of the chemical and allied industries, and 7.9% metals and metal products. Live animals, products of animal and plant origin, animal and vegetable fats and prepared food products constituted 10.7% of the total imports. The foreign trade deficit of agricultural products and prepared food products was 259.4 million euros in 2015. (SE, 2016)

### Main structural characteristics of farms, and upstream and downstream industries

1. Over the last 25 years, the structural development of Estonian farms, upstream and downstream industries has been influenced by the transition that began in the end of 1980-s and the beginning of 1990-s. After restoring the independence, agricultural, ownership and land reforms were initiated. The previous collective and state farms were privatised, and farmsteads were restituted to the pre-war owners or their heirs (Viira et al., 2009). As a result, the number of agricultural holdings increased from 1,154 in 1989 to 55,748 in 2001 (Figure 2.5). Since 2001, the number of agricultural holdings has been decreasing. Many of the farms established in the 1990-s on restituted land and farmsteads did not prove viable due to lack of skills and means for investment. In the 2000-s, farm exists were mainly driven by the age of the farm operators (retirement), with exists more probable in case of small farms (see also Figure 2.6), lack of successors interested in farming, and off-farm jobs in case of younger farm operators (Viira, 2014). In 2013, there were 19,186 agricultural holdings. However, the speed of reduction in number of agricultural holdings has slowed down in recent years. The number of agricultural holdings has declined mainly on the account of smaller farms (<20 ha). The number of holdings has increased only in size groups of 50-<100 ha and ≥100 ha of UAA (Figure 2.6).

**Figure 2.5. Number of agricultural holdings in Estonia 1989-2013**

Source: Statistics Estonia [AGS406]

**Figure 2.6. Number of agricultural holdings in size classes of UAA 2001-2013**

Source: Statistics Estonia [AGS406]

1. The structure of agricultural holdings in Estonia is dualistic. In 2013, 78.0% of holdings (<30 ha) managed 13.2% of UAA. At the same time, 0.8% of agricultural holdings managed 24.5% of UAA, and 3.5% of agricultural holdings (≥300 ha) managed more than half (53.2%) of the UAA (Figure 2.7). According to the OECD, in 2010, the mid-point farm size in crop farms was 275.9 ha, being 5th largest after Canada, USA, Latvia and Germany. Mid-point farm size of dairy farms was 363 LU, being 2nd largest after the USA (Bokusheva and Kimura, 2016). According to the size classes of UAA, livestock production is concentrated into agricultural holdings of <1 ha (23.9% of total LU, mainly pig and poultry farms that do not have agricultural land and that have a very high livestock density), and agricultural holdings of ≥500 ha (43.5% of LU, mainly cattle and pig farms) (Table 2.4). While the average standard output per annual work unit (AWU) was 30,700 euros in 2013, in size classes <1 ha, 100–<300 ha, 300–<500 ha, 500–<1000 ha, and ≥1000 it was above 43,300 euros.

**Figure 2.7. Share of agricultural holdings and UAA in size classes in 2013**

Source: Statistics Estonia [AGS406]

**Table 2.4. Distribution of UAA, livestock, standard output and labour in size groups of agricultural holdings in Estonia, 2013**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Size group, ha | | | | | | | | | | | |  |
|  | 0-<1 | 1-<2 | 2-<5 | 5-<10 | 10-<20 | 20-<30 | 30-<50 | 50-<100 | 100-<300 | 300- <500 | 500-<1000 | >=1000 | Total |
| Number of holdings | 597 | 1,605 | 4,140 | 3,974 | 3,340 | 1,403 | 1,182 | 1,152 | 1,131 | 278 | 244 | 141 | 19,186 |
| UAA, 1000 ha | 0.1 | 2.4 | 13.8 | 28.5 | 47.5 | 34.5 | 46.0 | 80.6 | 195.0 | 107.4 | 166.8 | 234.7 | 957.5 |
| Livestock, 1000 LU | 74.1 | 0.4 | 2.7 | 3.1 | 7.5 | 5.0 | 8.8 | 16.6 | 35.4 | 21.4 | 45.2 | 89.9 | 310.1 |
| Standard output, million euros | 70,8 | 2,4 | 7,5 | 10,6 | 19,7 | 13,6 | 21,0 | 39,3 | 98,6 | 60,3 | 112,7 | 219,8 | 676,3 |
| Labour input, AWU | 1,436 | 667 | 1,774 | 2,052 | 2,132 | 1,027 | 1,116 | 1,343 | 2,280 | 1,020 | 2,101 | 5,116 | 22,063 |
|  | | | | | | | | | | | | | |
| Number of holdings, % | 3,1 | 8,4 | 21,6 | 20,7 | 17,4 | 7,3 | 6,2 | 6,0 | 5,9 | 1,4 | 1,3 | 0,7 | 100,0 |
| UAA, % | 0,0 | 0,2 | 1,4 | 3,0 | 5,0 | 3,6 | 4,8 | 8,4 | 20,4 | 11,2 | 17,4 | 24,5 | 100,0 |
| Livestock,% | 23,9 | 0,1 | 0,9 | 1,0 | 2,4 | 1,6 | 2,9 | 5,4 | 11,4 | 6,9 | 14,6 | 29,0 | 100,0 |
| Standard output% | 10,5 | 0,4 | 1,1 | 1,6 | 2,9 | 2,0 | 3,1 | 5,8 | 14,6 | 8,9 | 16,7 | 32,5 | 100,0 |
| Labour input, % | 6,5 | 3,0 | 8,0 | 9,3 | 9,7 | 4,7 | 5,1 | 6,1 | 10,3 | 4,6 | 9,5 | 23,2 | 100,0 |
|  | | | | | | | | | | | | | |
| UAA, ha/holding | 0.1 | 1.5 | 3.3 | 7.2 | 14.2 | 24.6 | 39.0 | 70.0 | 172.5 | 386.5 | 683.8 | 1664.8 | 49.9 |
| Livestock, LU/holding | 124.2 | 0.2 | 0.7 | 0.8 | 2.2 | 3.6 | 7.5 | 14.4 | 31.3 | 76.9 | 185.1 | 637.3 | 16.2 |
| Livestock density, LU/UAA | 1140.29 | 0.16 | 0.20 | 0.11 | 0.16 | 0.15 | 0.19 | 0.21 | 0.18 | 0.20 | 0.27 | 0.38 | 0.32 |
| Standard output, 1000 euros/holding | 118.6 | 1.5 | 1.8 | 2.7 | 5.9 | 9.7 | 17.8 | 34.1 | 87.2 | 216.9 | 461.8 | 1,559.2 | 35.3 |
| Standard output, 1000 euros/AWU | 49.3 | 3.6 | 4.2 | 5.1 | 9.2 | 13.2 | 18.8 | 29.3 | 43.3 | 59.1 | 53.6 | 43.0 | 30.7 |
| Labour input, AWU/holding | 2.4 | 0.4 | 0.4 | 0.5 | 0.6 | 0.7 | 0.9 | 1.2 | 2.0 | 3.7 | 8.6 | 36.3 | 1.1 |

Source: Statistics Estonia [AGS406]

1. Transition towards larger farms poses questions about the accompanying effects on farm sustainability. Table 2.5 provides some farm sustainability indicators in farms size groups of the main Estonian farm types. It is evident that intensity of fertilizers and crop protection usage is higher in larger farms, as well as the average yield of wheat. Average wheat yield per cost of fertilizers and crop protection is higher in smaller farms that use less fertilizers and crop protection. Compared to fieldcrops farms, milk and mixed farms achieve higher wheat yields relative to costs of fertilizers and crop protection[[2]](#footnote-3). Average milk yield per cow is also larger in larger farms. There is a slight tendency towards higher livestock density in larger milk and other grazing livestock farms. 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 2014, average annual gross wage in agriculture, forestry and fishing was 10,956 euros. 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.

**Table 2.5. Some farm sustainability indicators in the main Estonian farm types and size classes, 2014**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Farm size group, ha | | | |  |
| Farm type | 0-<40 | 40-<100 | 100-<400 | 400-... | Total |
| *Fieldcrops* | | | | | |
| Use of fertilizers, euro/ha of UAA | 65 | 67 | 112 | 154 | 123 |
| Use of crop protection, euro/ha of UAA | 17 | 24 | 40 | 47 | 40 |
| Wheat yield, kg/ha | 2 798 | 3 350 | 3 903 | 4 290 | 4 011 |
| Ratio of wheat yield to costs of fertilizers and crop protection, kg/euro | 34.1 | 36.8 | 25.7 | 21.3 | 24.6 |
| Assets, euro/ha | 2 840 | 1 447 | 1 599 | 1 733 | 1 708 |
| Liabilities/assets, % | 3.3 | 21.1 | 29.9 | 34.8 | 28.9 |
| Farm income, euros | 346 | 6 599 | 20 217 | 47 975 | 11 708 |
| Farm income per unpaid farm labour, euros/AWU | 549 | 8 885 | 22 767 | 122 729 | 16 717 |
| *Milk* | | | | | |
| Use of fertilizers, euro/ha of UAA | 6 | 10 | 31 | 93 | 73 |
| Use of crop protection, euro/ha of UAA | 1 | 1 | 7 | 23 | 18 |
| Livestock density, LU/ha of UAA | 0.99 | 0.38 | 0.62 | 0.54 | 0.56 |
| Wheat yield, kg/ha | 3 086 | 2 713 | 3 431 | 4 449 | 4 269 |
| Ratio of wheat yield to costs of fertilizers and crop protection, kg/euro | 440.9 | 246.3 | 90.3 | 38.4 | 46.9 |
| Milk yield, kg/cow | 7 794 | 6 637 | 7 473 | 8 688 | 8 286 |
| Assets, euro/ha | 4 921 | 2 015 | 2 642 | 2 988 | 2 941 |
| Liabilities/assets, % | 41.4 | 7.9 | 32.9 | 45.2 | 41.1 |
| Farm income, euros | 4 454 | 11 414 | 26 184 | 16 962 | 10 883 |
| Farm income per unpaid farm labour, euros/AWU | 4 040 | 10 082 | 30 059 | 130 742 | 11 307 |
| *Other grazing livestock* | | | | | |
| Livestock density, LU/ha of UAA | 0.38 | 0.36 | 0.40 | 0.40 | 0.39 |
| Milk yield, kg/cow | 3 676 | 4 400 | 5 705 | 5 409 | 5 203 |
| Assets, euro/ha | 2 465 | 1 639 | 1 573 | 1 176 | 1 639 |
| Liabilities/assets, % | 11.1 | 6.3 | 43.8 | 17.7 | 24.6 |
| Farm income, euros | 223 | 5 081 | 5 250 | 26 012 | 3 295 |
| Farm income per unpaid farm labour, euros/AWU | 240 | 4 834 | 4 622 | 40 884 | 3 297 |
| *M* ixed | | | | | |
| Use of fertilizers, euro/ha of UAA | 9 | 15 | 48 | 108 | 71 |
| Use of crop protection, euro/ha of UAA | 3 | 4 | 17 | 33 | 23 |
| Livestock density, LU/ha of UAA | 0.23 | 0.14 | 0.21 | 0.50 | 0.35 |
| Wheat yield, kg/ha | 2 245 | 2 079 | 2 848 | 4 299 | 3 693 |
| Ratio of wheat yield to costs of fertilizers and crop protection, kg/euro | 187,1 | 109,4 | 43,8 | 30,5 | 39,3 |
| Milk yield, kg/cow | 4 861 | 6 652 | 6 590 | 7 379 | 7 191 |
| Assets, euro/ha | 3 994 | 1 539 | 1 676 | 2 123 | 2 126 |
| Liabilities/assets, % | 7.0 | 11.7 | 27.9 | 35.4 | 26.6 |
| Farm income, euros | 3 488 | 4 068 | 17 292 | 11 256 | 5 739 |
| Farm income per unpaid farm labour, euros/AWU | 3 997 | 3 920 | 15 084 | 159 012 | 6 390 |

Source: FADN (2016)

1. Over the years, the concentration of UAA (and agricultural production) to larger agricultural holdings has increased. Figure 2.8 depicts the respective Lorenz curves for 2001 and 2013. It appears that inequality of distribution of UAA between agricultural holdings has slightly increased.

**Figure 2.8. Lorenz curve of number of agricultural holdings and their use of UAA in 2001 and 2013**

Source: Statistics Estonia [AGS406]

1. Among the selected countries, Estonia and Czech Republic have the most large farm dominated structure with the proportion of UAA managed in agricultural holdings of ≥100 ha, 73.5% and 87.8% respectively (Table 2.6). In the Netherlands and Poland, the agricultural holdings of ≥100 ha managed 20.0% and 21.1% of UAA, respectively. However, from the selected countries, Poland has the most small-farm dominated farm structure: agricultural holdings of <30 ha manage 58.5% of UAA.

**Table 2.6. Structure of agricultural holdings and UAA (%) in selected countries in 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 |

Source: Eurostat [ef\_kvaareg]

1. In recent years, the number of food manufacturing enterprises has increased by 33.0% from 358 in 2010 to 476 in 2014 (Figure 2.8). This increase is mainly due to (65.2%) increase of micro enterprises of 1-9 employees. From 2010-14, there has been slight increase in the number of enterprises in size classes 50-99, 100-249 and ≥250 employees.

**Figure 2.8. Number of enterprises in manufacturing of food products in Estonia 2005-14 according to size classes (number of employees)**

Source: Statistics Estonia [FS001]

1. Like in the farming sector, the structure of food processing industry is dualistic. However, this applies to all the observed countries. In 2013, in Estonia, there were 10 (2.2%) large (≥250 employees) enterprises, which total turnover comprised 30.5% of the aggregate turnover of food manufacturing industry (Table 2.7). 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 Estonian large food manufacturing enterprises are smaller compared to their competitors in the selected countries. Average turnover per enterprise of large Estonian food industry companies was 46.3 million euros in 2013. This figure was smaller only in Latvia. The average turnover of large Danish and Dutch food industry enterprises exceeded the Estonian figure by 11.8 and 10.9 times respectively.

**Table 2.7. Share of enterprises and turnover, and average turnover per enterprise of various size classes in food industry total in selected countries, 2013**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Size group, number of employees | | | | |
|  |  | 0-9 persons | 10-19 persons | 20-49 persons | 50-249 persons | ≥250 persons |
| Czech Republic | Enterprises, % | 81.5 | 6.6 | 6.7 | 4.4 | 0.8 |
| Turnover, % | 3.5 | 3.1 | 12.2 | 44.0 | 37.2 |
| Turnover per enterprise, million euros | 0.1 | 0.8 | 2.9 | 15.9 | 73.2 |
| Denmark | Enterprises, % | 56.2 | 22.6 | 11.0 | 8.2 | 2.1 |
| Turnover, % | 2.3 | 2.2 | 6.9 | 21.3 | 67.2 |
| Turnover per enterprise, million euros | 0.7 | 1.7 | 10.5 | 43.6 | 544.2 |
| Estonia | Enterprises, % | 61.0 | 13.3 | 12.0 | 11.5 | 2.2 |
| Turnover, % | 2.6 | 4.6 | 10.6 | 51.8 | 30.5 |
| Turnover per enterprise, million euros | 0.1 | 1.2 | 3.0 | 15.1 | 46.3 |
| Latvia | Enterprises, % | 67.3 | 8.9 | 11.1 | 10.7 | 2.0 |
| Turnover, % | 3.2 | 3.1 | 12.0 | 48.0 | 33.8 |
| Turnover per enterprise, million euros | 0.1 | 0.6 | 2.0 | 8.2 | 30.1 |
| Lithuania | Enterprises, % | 68.6 | 10.1 | 10.5 | 8.5 | 2.2 |
| Turnover, % | 0.9 | 1.8 | 6.4 | 27.3 | 63.6 |
| Turnover per enterprise, million euros | 0.04 | 0.5 | 1.6 | 8.4 | 75.2 |
| Netherlands | Enterprises, % | 75.5 | 10.8 | 6.6 | 5.9 | 1.2 |
| Turnover, % | 2.7 | 3.2 | 8.0 | 35.3 | 50.8 |
| Turnover per enterprise, million euros | 0.4 | 3.6 | 14.7 | 73.1 | 503.6 |
| Poland | Enterprises, % | 64.8 | 12.1 | 12.1 | 8.9 | 2.2 |
| Turnover, % | 3.3 | 3.2 | 8.3 | 29.0 | 56.1 |
| Turnover per enterprise, million euros | 0.2 | 1.0 | 2.7 | 12.8 | 101.8 |
| Finland | Enterprises, % | 78.4 | 9.1 | 7.0 | 4.7 | 0.8 |
| Turnover, % | 4.8 | 3.9 | 10.3 | 28.2 | 52.7 |
| Turnover per enterprise, million euros | 0.4 | 2.6 | 9.0 | 36.3 | 406.6 |
| Sweden | Enterprises, % | 80.1 | 9.4 | 6.1 | 3.5 | 0.8 |
| Turnover, % | 5.5 | 4.6 | 8.7 | 34.9 | 46.3 |
| Turnover per enterprise, million euros | 0.3 | 2.4 | 7.0 | 48.7 | 288.9 |

Source: Eurostat [sbs\_sc\_sca\_r2]

1. One of the weaknesses of Estonian food manufacturing industry is its relatively low labour productivity. In 2013, value added at factor cost per employed person was 20,400 euros (Figure 2.9). While it exceeded the Latvian, Lithuanian and Czech Republic’s figures, it is on par with the performance of food manufacturers in Poland. Compared to Scandinavian countries, value added per employed person in Estonian food industry is approximately three times lower. In most of the selected countries, except in Czech Republic and Denmark, labour productivity in food industry exceeds the labour productivity in farms[[3]](#footnote-4). The labour productivity gap between food industry and agriculture was one of the lowest in Estonia. Compared to Finland, the labour productivity in Estonian food manufacturing companies comprised 33.8%, while in farms labour productivity in Estonia comprised 67.5% of the Finnish figure.

**Figure 2.9. Labour productivity in food manufacturing industry and farms in the selected countries, 2013**

Source: Eurostat [sbs\_sc\_sca\_r2], FADN (2016b)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Box 2.1. On the competitveness of Estonian dairy processing industry In their study "Competitiveness of Northern European dairy chains", Jansik et al. (2014) concluded that Estonian dairy processing industry is fragmented with foreign investors divesting in the 2000-s, leaving the industry with one considerable professional foreign owner, Finnish Valio which is the biggest manufacturer in terms of turnover with 99.2 million euros of sales revenue in 2012. The four leading companies purchased 58% of raw milk in 2012. One of the challenges of 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 frequents shifts to new flavours, which increase costs. They conclude that the average annual TFP growth in Estonian dairy processing industry was merely 0.3% in the period from 2000-11.  Viira et al. (2015) found that Estonian and Latvian dairy processing industry lack competitiveness in the raw milk market of Baltic countries. While Estonian dairy industry processesed 74.8%, and Latvian dairy industry processed 72.0% of collected raw milk in 2014, 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. One of the reasons for this could be lack of milk processing capacity in Estonian dairy industry. However, there are no official figures on the capacity utilization, and some experts state that there exists sufficient capacity, but probably it is outdated and inefficient.  In Estonian dairy industry the productivity measured in quantity of processed milk per employee per year falls significantly behind the figures in the Netherlands, Germany and Ireland (Table 2.8). Also, the production value per kg of processed milk is below the figures in the Netherlands, Finland and Germany. In order to increase competitiveness, Estonian dairy industry needs to consolidate, invest into automation to achieve higher processed milk volume per employee, and to increase the value of production per kg of processed milk (Viira et al., 2015).  **Table 2.8. Production value, number of employees, milk processed and labour productivity in the manufacture of dairy products in the selected countries, 2013**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | |  | Estonia | Latvia | Lithuania | Netherlands | Finland\* | Germany | Ireland\* | | Production value, million euros | 362 | 368 | 1,069 | 10,358 | 2,529 a | 28,583 | 3,671 | | Number of employees | 2,088 | 3,120 | 7,607 | 12,695 | 6,072 a | 42,068 | 5,260 | | Milk processed, 1000 t | 501 | 524 | 1,649 | 11,925 | 2,275 | 30,905 | 5,476 | | Milk processed per employee, t | 240 | 168 | 217 | 939 | 375 | 735 | 1,041 | | Production value per employee, 1000 euros | 173 | 118 | 141 | 816 | 417 | 680 | 698 | | Production value per kg of processed milk, euros | 0.72 | 0.70 | 0.65 | 0.87 | 1.11 | 0.92 | 0.67 |   \*Data from 2012  Source: Viira et al. (2015) on the basis of Eurostat (2015), in the case of Finland, the data with superscript a are from Statistics Finland (2015) |

### The main food and agriculture outputs and markets

1. For many years, milk was the single largest item of agricultural (crop and animal) output, comprising around 30% of the output value (Figures 2.10 and 2.11). However, since 2004, the contribution of cereals and oilseeds to agricultural output has increased. In 2003-05, milk comprised 31.4% of aggregated crop and animal output, cereals and oilseeds contributed 14.8% and 4.3% (19.1% in total), respectively. In 2013-15, cereals comprised 23.2%, oilseeds 7.7% (30.9% in total), and milk 27.5% of aggregated crop and animal output. It has to be borne in mind that these proportions are calculated based on current prices, and in 2015, farm gate milk prices were low and cereal yields were all time highest. The indices of meat, milk and cereals production quantities (Figure 2.12) reveal that from 1998-2015, (3-year moving average) cereal production has increased by 132.9%, meat production (in slaughter weight) by 38.7%, and milk production by 6.1%. However, due to improvements in milk quality and structural changes in dairy farming sector, milk collection has increased by 98.8%. Besides cereals and oilseeds, the share of poultry in aggregated crop and animal output has increased from 2.5% in 1998-2000 to 3.6% in 2013-15. The share of other outputs in aggregated output has declined.

**Figure 2.10. Output of crop and animal products in Estonia, 1998-2015, 3-year averages, current prices**

Source: Statistics Estonia [AG54]

**Figure 2.11. Share of crop and animal output in aggregated output of crop and animal products in Estonia, 1998-2015, 3-year averages**

Source: Statistics Estonia [AG54]

**Figure 2.12. Index of meat, milk and cereals production, 1998-2015 (1998=100)**

Source: Statistics Estonia [AG04, AG10, AG11]

1. In 2015, the balance of trade of agricultural and food products (HS chapters 01-23) was -222.9 euros (Table 2.9). The trade surplus was largest in cases of cereals (124.2 million euros) and dairy products (83.3 million euros). Also, the trade balance of live animals (29.4 million euros), fish (20.7 million euros), preparations of meat and fish (15.9 million euros), animal or vegetal fats and oils (14.3 million euros) and vegetable plaiting materials (0.3 million euros) were positive. While Estonia was net exporter of live animals, and preparations of meat and fish, Estonia was net importer of meat (-42.9 million euros), fruits (-75.1 million euros), vegetables (-33.0 million euros), and preparations of vegetables and fruits (-46.4 million euros). The fact that Estonia is net exporter of cereals, and net importer of products of milling industry, and preparations of cereals, flour, starch or milk; and net exporter of live animals and net importer of meat, suggests that the capacity and competitiveness of food manufacturing industry has not developed as quickly as the agricultural output.
2. In 2015, according the trade surplus, the top 10 agricultural and food product groups (at 4-digit CN code level) were wheat (CN code 1001, trade surplus 73.5 million euros), barley (1003, 45.3 million euros), frozen fish (0303, 31.7 million euros), milk and cream (0401, 31.4 million euros), rape oil (1514, 29.4 million euros), dried or salted fish (0305, 26.9 million euros), cheese (0406, 24.3 million euros), sauces and preparations thereof (2103, 23.0 million euros), live bovine animals (0102, 17.4 million euros), yeasts and prepared baking powders (2102, 16.9 million euros).

**Table 2.9. Import and export of agricultural and food products in Estonia in 2015, million euros**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Chapter of HS** | **Import** | **% of total imports** | **Export** | **% of total exports** | **Balance** |
| 10 Cereals | 18.7 | 0.1% | 142.9 | 1.2% | 124.2 |
| 04 Dairy products, eggs, honey | 65.0 | 0.5% | 148.3 | 1.3% | 83.3 |
| 01 Live animals | 3.7 | 0.0% | 33.1 | 0.3% | 29.4 |
| 03 Fish | 129.2 | 1.0% | 149.9 | 1.3% | 20.7 |
| 16 Preparations of meat and fish | 50.9 | 0.4% | 66.8 | 0.6% | 15.9 |
| 15 Animal or vegetable fats and oils | 28.8 | 0.2% | 43.2 | 0.4% | 14.3 |
| 14 Vegetable plaiting materials, other vegetal products | 0.1 | 0.0% | 0.4 | 0.0% | 0.3 |
| 13 Lac, gums, resins | 1.6 | 0.0% | 1.1 | 0.0% | -0.5 |
| 12 Oil seeds | 22.6 | 0.2% | 20.0 | 0.2% | -2.7 |
| 21 Miscellaneous edible preparations | 106.0 | 0.8% | 102.9 | 0.9% | -3.1 |
| 05 Other animal products | 6.1 | 0.0% | 2.2 | 0.0% | -3.8 |
| 11 Products of milling industry | 19.2 | 0.1% | 12.8 | 0.1% | -6.4 |
| 19 Preparations of cereals, flour, starch or milk | 79.4 | 0.6% | 65.4 | 0.6% | -14.0 |
| 06 Live trees and plants | 23.4 | 0.2% | 3.6 | 0.0% | -19.9 |
| 17 Sugars and sugar confectionery | 42.3 | 0.3% | 12.2 | 0.1% | -30.1 |
| 07 Vegetables | 55.7 | 0.4% | 22.8 | 0.2% | -33.0 |
| 18 Cocoa and cocoa preparations | 53.4 | 0.4% | 15.0 | 0.1% | -38.4 |
| 09 Coffee and tea | 58.3 | 0.4% | 17.4 | 0.1% | -40.9 |
| 02 Meat | 92.6 | 0.7% | 49.7 | 0.4% | -42.9 |
| 20 Preparations of vegetables and fruits | 62.5 | 0.5% | 16.2 | 0.1% | -46.4 |
| 23 Residues and waste from food industry | 71.5 | 0.5% | 18.0 | 0.2% | -53.5 |
| 08 Fruit | 97.6 | 0.7% | 22.5 | 0.2% | -75.1 |
| 22 Beverages, spirits and vinegars | 268.8 | 2.1% | 163.4 | 1.4% | -105.3 |
| **Total** | **1357.4** | **10.4%** | **1129.5** | **9.7%** | **-222.9** |

Source: Eurostat Traditional international trade database (ComExt)

1. In 2015, of the agricultural and food products imported to Estonia, 93.1% (based on value) were imported from the EU28 countries. Of the agricultural and food exports from Estonia, 72.5% (based on value) were exported to the EU28 countries. The neighbouring countries Latvia, Lithuania, Finland, Sweden and Russian Federation are the main trade partners in agricultural and food products. However, after imposing import ban in August 2014, trade with Russian Federation has markedly declined, causing problems especially in dairy sector.

|  |
| --- |
| **Box 2.2. The spread of African Swine Fever and its impact on the pig farming sector**  African Swine Fever (ASF) was first diagnosed among the Estonian wild boar population in September 2014. Less than a year later, in the summer of 2015, the first cases of ASF were confirmed in domestic pigs. This led to severe disease outbreak at pig farms, which subsided by the end of September of the same year. A new ASF outbreak in domestic pigs flared about a year later and subsided again by the end of summer. Since the area where both domestic and feral pigs have been affected has spread since 2015, swine herds are faced with high level of exposure.  As compared to 2015/2016, around 53.0% of pig farmers closed down their businesses due to the spread and threat of ASF. The number of pigs kept on farms decreased by 11.2%, dropping from 328,000 pigs in 2015 to 291,000 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). Although the number of pigs has decreased, self-sufficiency in pork production is still maintained.  The spread of ASF among Estonian feral and domestic pig herds has brought about additional investments into ensuring the compliance with biosafety and biosecurity regulations and led to major economic losses due to the restrictions imposed on trading and processing of pork.  The future development of pig farmers and entrepreneurs may slow down as the returns on assets and equity are low and further investments are not cost-effective. The average level of debt to equity ratio is 0.52, which shows that, on average, the entrepreneurs can increase the share of external capital by 15-20%. However, the high level of risk in pig sector associated with the spread of ASF and the low market price of pork will probably discourage these developments.  Source: EMU (2016e) |

### Trends in agricultural productivity and sources of total factor productivity growth

1. In the review of the productivity trends in Estonian agriculture, the focus is on milk and cereals because these give the largest contribution to agricultural output (in 2015, 19.8% and 24.3%, respectively). Estonia’s indicators from 1992-2014 are compared to the indicators of the selected countries. The following indicators are selected for the comparisons:

* Productivity: milk and wheat yield, agricultural value added per worker, total factor productivity (TFP) and its determinants.
* Volume: number of dairy cows, milk and cereals output, sown area of cereals, crop and livestock production indices.
* Intensity of livestock production: livestock density.
* The main technologies used in milk production.

1. From 1994-2013, increase in average milk yield has been fastest in Estonia (132%, an average of 4.5% per year), followed by the Czech Republic (87%, 3.3% per year) and Lithuania (86%, 3.3% per year). The increase was the smallest in the Netherlands (19%, 0.9% per year) and in Sweden (26%, 1.2% per year) (Figure 2.12). In 1994, the average milk yield (3.3 tonnes/cow/year) in Eastern European countries (Estonia, Latvia, Lithuania, Poland and the Czech Republic) was approximately two times lower compared to Canada, Denmark, Finland, The Netherlands and Sweden. The comparatively low base level of milk yield in Estonia and the Czech Republic gave these countries a head start for a relatively fast growth, while Latvia, Lithuania and Poland could not be in step with the changes (technological development, improved feeding, breeding, structural change) so quickly, and therefore, the average milk yield in these countries still remains below 6 tonnes/cow/year.

**Figure 2.12. Milk yield, tonnes per cow in selected countries, 1994-2013**

Source: FAOSTAT, Livestock Primary: Milk Animals; Production

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| --- |
| Box 2.3. Structure of Estonian dairy farms Existence of large herds has through improved housing conditions and better dairy cattle feeding and management contributed to the rapid growth of milk yield in Estonia, and ensured a marked rise in the productivity of a large number of cows. In 2013, in Estonia, 79.7% of the dairy cattle population was in herds of over 100 cows by 7.8% of holdings (Figure 2.13).  From 2001-13, the number of holdings with small dairy herds (1-9 dairy cows) declined by 88.5% and the number of dairy cows in the small herds decreased by 86.0%. At the same time, the number and share of larger herds (≥300 cows) has increased by 22.4%, and the number of cows, which kept in these herds increased by 37.2%. The benefits of larger herds include achieving the economies of scale and the concentration of knowledge into larger units that will help to ensure high-quality cost-effective production. Luik et al. (2014) showed that in Estonia, larger herds are more efficient. This can be attributed to larger investments in larger cowsheds, which result in the introduction of modern technology and ensuring better housing conditions and, hence, higher milk yield and the higher quality of milk.  **Figure 2.13. The share of holdings and cows according to the herd size, 2001-13**    Source: Statistics Estonia [PMS005] |
|  |
| Box 2.4. Estonian dairy farms’ technologies In 2013, a farm survey *Efficiency of utilization of the main production resources in Estonia* was carried out by the Institute of Economics and Social Sciences of the Estonian University of Life Sciences (EMU). The main aim of the research was to gather the information about the dairy farms’ technologies. 326 milk farms responded that had in total 366 dairy barns.  **Dairy barns:** 50% of the barns had <50 places for dairy cows,67% of the barns had <100 places. 70% of barns had tethered housing, and 30% of the barns were of loosed housing type. Majority of barns with tethered housing were small: 80% of these had places for <100 cows and most of them were constructed before 2001. 70% of the loose housing barns had space for >100 cows and most of these were constructed after 2001.  **Milking technologies:** 38% of the respondents had pipeline milking system, and 30% bucket milking (these milking systems are more widespread in smaller and older barns); 26% had milking parlour or carousel, and 6% had automated milking system (robots). New barns (constructed after 2001) usually have milking parlours or robots.  **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 are grazed 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 are grazed only in daytime during the grazing period. In 21% of the farms (average 377 places for dairy cows), cows are not grazed 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 were grazed during the grazing period, and in 23% of the farms, cows were kept indoors the whole year round.  **Manure:** in 64% of barns, 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 insert manure into soil immediately.  Most of the managers of dairy farms are working full time in the farm. 11.6% of the respondents declared that they also have an off-farm job.  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 agri-environment. |

1. From 1994-2013, the number of dairy cows decreased in Estonia by 56.9%, which is the largest decline in the selected countries, but as the milk yield increased by 132%, the total milk production did not decrease (Table 2.10). After regaining independence, milk production in Estonia began to decline, hitting the bottom at 610,000 tonnes in 2003. Joining the EU had a positive effect on agriculture and milk production, and since 2004, total milk production has been on the rise. In 2013, total milk production recovered to the level of 1994. Milk production declined in other Baltic countries as compared to 1994. While the reduction in the number of dairy cows in Latvia and Lithuania (over 50%) is comparable to Estonian figure, improvement in average milk yield in Latvia and Lithuania has been less rapid. Compared to 1994, milk production in Sweden and Finland has suffered the biggest decline by 2013. Total milk production has increased in Denmark, Canada, the Netherlands, and Poland in 1994-2013.

**Table 2.10. Number of dairy cows and milk production, 1994-2013, 1000 heads and 1000 tonnes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1994 | | 1999 | | 2004 | | 2009 | | 2013 | | Change (%)  1994-2013 | | Change (%)  2004-2013 | |
| Cows | Prod. | Cows | Prod. | Cows | Prod. | Cows | Prod. | Cows | Prod. | Cows | Prod. | Cows | Prod. |
| Canada | 1224 | 7750 | 1157 | 8164 | 1055 | 7905 | 978 | 8213 | 961 | 8394 | -21.5 | 8.3 | -8.9 | 6.2 |
| Czech Republic | 768 | 3134 | 545 | 2818 | 437 | 2680 | 394 | 2781 | 373 | 2849 | -51.5 | -9.1 | -14.6 | 6.3 |
| Denmark | 700 | 4442 | 640 | 4655 | 589 | 4569 | 563 | 4814 | 582 | 5105 | -16.8 | 14.9 | -1.2 | 11.7 |
| Estonia | 227 | 771 | 150 | 626 | 117 | 652 | 97 | 671 | 98 | 772 | -56.9 | 0.0 | -16.2 | 18.4 |
| Finland | 417 | 2512 | 372 | 2403 | 328 | 2449 | 290 | 2332 | 283 | 2328 | -32.1 | -7.3 | -13.7 | -4.9 |
| Latvia | 351 | 1000 | 216 | 797 | 186 | 784 | 170 | 828 | 165 | 912 | -53.0 | -8.8 | -11.3 | 16.3 |
| Lithuania | 648 | 1896 | 538 | 1702 | 448 | 1842 | 375 | 1787 | 316 | 1720 | -51.3 | -9.3 | -29.5 | -6.6 |
| Netherlands | 1698 | 10873 | 1588 | 11174 | 1502 | 10905 | 1572 | 11469 | 1597 | 12207 | -5.9 | 12.3 | 6.3 | 11.9 |
| Poland | 3802 | 12222 | 3077 | 12284 | 2770 | 11822 | 2606 | 12447 | 2361 | 12718 | -37.9 | 4.1 | -14.8 | 7.6 |
| Sweden | 509 | 3421 | 449 | 3299 | 404 | 3275 | 357 | 2974 | 344 | 2910 | -32.5 | -14.9 | -14.9 | -11.1 |

Source: FAOSTAT, Livestock Primary: Milk Animals; Production

1. From 2004-13, milk production in Estonia and other European countries was on the rise. Of the countries under review, Estonia (18.4%), Latvia (16.3%), Denmark (11.7%), and the Netherlands (11.9%) have demonstrated the biggest growth. Milk production continued its growth in 2014, increasing by 4.3% compared to 2013. The withdrawal of milk quotas in the EU in 2015 (that was announced in 2008), which led to increased production volumes (from 2008-14, milk production in the EU increased by 10.5 million tonnes (7.1%) (Viira et al., 2015)), has had a negative impact on milk producer prices across Europe and put milk producers under severe economic pressure. In 2015, Estonia’s milk production declined by 2.7% to 783.2 thousand tonnes, number of dairy cows increased by 5.2% and average annual milk yield increased by 2.5% to 8,442 kg/cow.

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| Box 2.4. Dynamics of dairy farm productivity growth in the Estonia Kimura and Sauer (2015) investigated the impact of various factors on the TFP growth at the farm level in dairy sector in Estonia, the Netherlands, United Kingdom and Germany in the period from 2003-12. Their research showed that the exit of inefficient farms is one of the most important drivers of productivity growth in the dairy farm sector. They found that in Estonia, herd size, higher milk yield and higher stocking rate had a positive impact on the productivity level. Labour input per cow and the intensity of purchased feed input had a negative correlation with productivity. Net investment had a negative impact on the TFP, but its productivity-enhancing effect is likely to be delayed. They concluded that efficient management of labour and feed inputs could be one of the determinants of dairy farm productivity. Figure 2.14 compares the evolution of TFP and total input and output in Estonian dairy farms. The annual TFP growth was positive in three out of nine years, while total input and output increased in six out of nine years. The expansion of the dairy sector mainly took place during the period 2003-08, following EU accession, and it slowed down in recent years.  Figure 2.14. Evolution of TFP, output and input indices of Estonian dairy farm sector (2003=100)  According to Kimura and Sauer (2015) the TFP growth of the Estonian dairy farm sector in 2003-12 is decomposed into three components: within-farm productivity growth, resource reallocation effect and entry-exit effect (Figure 2.15). The average within-farm productivity growth is negative, which means that the productivity of existing farms has declined. The entry-exit effect is also negative on average, but increased in 2009 and 2010, when milk price was low and many small and ineffective producers decided to stop producing milk and exited from the market. The resource reallocating effect is positive on average. It means that resources have concentrated into more productive farms. They pointed out that the main driver of productivity in Estonian dairy farm sector is the farm expansion and increasing milk yield by a few numbers of productive large farms.  Figure 2.15. Decomposition of TFP growth in the Estonian dairy farm sector |

1. In order to compare the yield trends of cereals, the trends of wheat yields in selected countries in the period from 1992-2014 are reviewed (Figure 2.16). The most significant increase in yields was observed in the Baltic countries – in Estonia (97.5%, an average of 4.2% per year), Lithuania (85.8%, 3.7% per year) and Latvia (79.3%, 3.5% per year). Despite the increase in yields, these countries have still relatively low yields compared to the Netherlands, Denmark, Sweden and Czech Republic. The yield depends primarily on the amount of soil conditioners and plant protection products used – the more inputs used, the higher the yield applies. In the Netherlands and Denmark, where the wheat yields are highest, the application of nitrogen (N) and phosphorus (P) are also highest, while Estonia and Latvia, that have low yields, have used the smallest amount of N and P per ha (Gross Nutrient Balance [aei\_pr\_gnb], Eurostat). In 2015, which was a very favourable year for cereal production, a record wheat yield (4.79 tonnes/ha) was achieved in Estonia (PM041).

Figure 2.16. Wheat yield, 3-years average, t/ha

Source: FAOSTAT [Production, Crops]

1. Rapid growth in wheat and cereal yields in general has contributed to an increase in total cereal production (Table 2.11). From 1994-2013, total cereal production growth was fastest in Latvia (117.5%), Lithuania (112.5%) and Estonia (90.6%). The rapid increase in cereal production in Latvia has, in addition to a rise in cereal yields, also derived from an increase in the land under cereal production (by 19.4%). Out of the reference countries, the sown area of cereal crops is the largest in Canada, where in 1994-2013, the cereal area decreased by 11.4%, whereas the total production increased by 42.4%. This resulted from a 61% increase in the yield. The area under cereals is the smallest in the Netherlands, which is about 100,000 ha less than in Estonia. The total output of cereals in the Netherlands is about two times higher than that in Estonia, which can be explained by about threefold higher yield. Thus, land productivity in Estonia is comparatively low and therefore, in spite of an increase in the past two decades, the cereal yield in Estonia is still the lowest.

Table 2.11. Land under cereal production and total production of cereals in 1993-2013, 1000 ha and 1000 tonnes

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1994 | | 1999 | | 2004 | | 2009 | | 2013 | | Change (%) 1994-2013 | | Change (%) 2004-13 | |
| Ha | Prod. | Ha | Prod. | Ha | Prod. | Ha | Prod. | Ha | Prod. | Ha | Prod. | Ha | Prod. |
| Canada | 17965 | 46617 | 17514 | 54078 | 16162 | 50778 | 15027 | 49552 | 15917 | 66372 | -11.4 | 42.4 | -1.5 | 30.7 |
| Czech Republic | 1662 | 6799 | 1597 | 6940 | 1617 | 8804 | 1544 | 7837 | 1431 | 7517 | -13.9 | 10.6 | -11.5 | -14.6 |
| Denmark | 1410 | 7800 | 1497 | 8774 | 1491 | 8963 | 1499 | 10164 | 1444 | 9104 | 2.4 | 16.7 | -3.1 | 1.6 |
| Estonia | 320 | 510 | 321 | 402 | 261 | 608 | 316 | 873 | 312 | 973 | -2.5 | 90.6 | 19.4 | 60.0 |
| Finland | 948 | 3400 | 1134 | 2882 | 1127 | 3619 | 1133 | 4261 | 1104 | 4084 | 16.4 | 20.1 | -2.1 | 12.8 |
| Latvia | 484 | 896 | 399 | 784 | 433 | 1060 | 541 | 1663 | 578 | 1949 | 19.4 | 117.5 | 33.4 | 83.9 |
| Lithuania | 1195 | 2098 | 1013 | 2048 | 879 | 2859 | 1104 | 3807 | 1211 | 4459 | 1.3 | 112.5 | 37.8 | 56.0 |
| Netherlands | 189 | 1355 | 183 | 1368 | 217 | 1823 | 221 | 1994 | 209 | 1811 | 10.7 | 33.6 | -3.5 | -0.7 |
| Poland | 8481 | 21763 | 8701 | 25750 | 8377 | 29635 | 8504 | 29571 | 7476 | 28428 | -11.9 | 30.6 | -10.8 | -4.1 |
| Sweden | 1149 | 4472 | 1153 | 4931 | 1126 | 5508 | 1032 | 5242 | 973 | 4985 | -15.3 | 11.5 | -13.6 | -9.5 |

Source: The World Bank, Land under cereal production; FAOSTAT, Cereals production

1. Changes in total cereal production and sown areas under cereals in 2004-13 differ from the changes that took place in 1994-2003. Table 2.11 shows that the production of cereals in the Czech Republic, Poland and Sweden has declined since 2004, although as compared to 1994, total cereal production has increased. As to changes in the sown area of cereals, it should be pointed out that in the Czech Republic, Poland and Sweden, the sown area of cereals has decreased over the past 20 years, by 13.9%, 11.9% and 15.3% respectively, whereas the significant fall in the sown area took place in the past decade (by 11.5%, 10.8 % and 13.6% respectively). The most significant change that can be identified in Estonia is that during 1994-2013 the sown area of cereal decreased by 2.5%, however, in the past decade (2004-2013) the area under cereal has increased by 19.4%.
2. The crop production index shows the agricultural production for each year relative to the base period 2004-06 (Figure 2.17). It includes all crops except fodder crops. Regional and income group aggregates for the FAO production indexes are calculated from the underlying values in international dollars, normalized to the base period 2004-06. (Crop production index, The World Bank) As crop production, and thus also production value is heavily dependent on the weather, the 3-year mean of the crop production index is used to better characterise the trend. Crop production index is the highest in the Baltic countries, which means that crop production growth has been the greatest in these countries.

**Figure 2.17. Crop production index (2004-06=100)**

Source: The World Bank, Crop production index

1. The livestock production index includes meat and milk from all sources, dairy products, eggs, honey, raw silk, wool, and hides and skins. (Livestock Production Index, The World Bank) Since 2004, an increase in livestock production index has been the fastest in Estonia and Latvia, followed by the Netherlands in the third place (Figure 2.18).

Figure 2.18. Livestock production index (2004-06=100)

Source: The World Bank

1. The livestock density index[[4]](#footnote-5) is an indicator of the pressure of livestock farming on the environment. Livestock, through manure production, contributes to climate change (GHG emissions) and nutrient leaching into water and air. A higher livestock density means that a higher amount of manure is available per ha of UAA, which increases the risk of nutrient leaching. The actual impact of livestock farming on the environment does not only depend on the amount of livestock, but also on farming practices (e.g. grazing, equipment and timing of manure spreading etc.). An increase in the livestock density index does not therefore necessarily need to lead to environmental degradation. Among the observed countries, the livestock density index is the lowest in Estonia, Lithuania and Latvia (Table 2.12). From 2003-13, the livestock density index has decreased in all comparable countries, except the Netherlands, where the it increased by 16%.

Table 2.12. Livestock density index, LU/ha

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2003 | 2005 | 2007 | 2010 | 2013 | Change 2003-13 |
| Latvia | 0.31 | 0.27 | 0.28 | 0.26 | 0.26 | -16% |
| Lithuania | 0.47 | 0.46 | 0.39 | 0.33 | 0.29 | -38% |
| Estonia | 0.41 | 0.38 | 0.35 | 0.33 | 0.32 | -22% |
| Czech Republic | 0.63 | 0.58 | 0.58 | 0.49 | 0.50 | -21% |
| Finland | 0.53 | 0.51 | 0.50 | 0.49 | 0.51 | -4% |
| Sweden | 0.59 | 0.57 | 0.57 | 0.57 | 0.56 | -5% |
| Poland | 0.77 | 0.72 | 0.72 | 0.72 | 0.64 | -17% |
| Denmark | 1.71 | 1.69 | 1.72 | 1.86 | 1.58 | -8% |
| Netherlands | 3.07 | 3.26 | 3.35 | 3.58 | 3.57 | 16% |

Source: Eurostat, Livestock density index; Knoema, Livestock density index

1. In Estonia, the livestock density has been relatively low, but it differs according to the size classes. Table 2.5 provides information on the variation of livestock density in different Estonian farm types and size classes in 2014. Livestock density is highest in farms that are specialised on granivores (pig and poultry production). However, such farmers have contracts with fieldcrops farms on manure spreading. In milk, other grazing livestock, and mixed farms, average livestock density increases with farm size. In Estonia, the most concentrated livestock sub-sectors are pig and poultry farming. In 2013, 39 pig farms (5.2%, >2000 pigs each) housed 91.5% of pigs. Broilers were kept in 56 holdings (1.5% of holdings with poultry), which kept 58.4% of total poultry (SE, 2016).
2. To describe labour productivity, agriculture value added per worker is analysed. Value added in agriculture measures the output of the agricultural sector less the value of intermediate inputs. The Netherlands, Sweden, Denmark and Sweden are clearly distinguished from the others for their higher labour productivity (Figure 2.19), whereas Poland, the Czech Republic and the Baltic countries have over the years been characterised by low labour productivity.

**Figure 2.19. Agriculture value added per worker (constant 2005 US$)**

Source: The World Bank., Agriculture value added per worker\*

\*Data was unavailable for Canada

1. The agricultural TFP index has undergone a major change in Estonia, particularly in view of longer time span (Figures 2.20-2.22). From 1966 until the end of the 1970s the TFP was relatively stable and significantly higher than in 1992. Since 1980, the TFP started to decline, and the downward trend continued until the early 2000s when it started to recover due to EU subsidies and a more favourable agricultural policy, which stimulated investments, use of intermediate inputs and resulted in increased production. The rise in production volume in Estonia has been one of the highest as compared to other reference countries. Due to the introduction of modern technology and rapid growth in knowledge, the increase in output has been faster than that in inputs. However, the TFP has risen in all countries. The average TFP index in Europe has also experienced a strong growth. In Estonia, this increase has exceeded the European average, whereas in the neighbouring countries (Latvia and Lithuania) the TFP growth has remained below the European average.

Figure 2.20. Agricultural total factor productivity index (1992=100)

Source: USDA, Economic Research Service, Agricultural Productivity Database, Agricultural TFP Growth

\*Data for Czech Republic is unavailable; therefore, the data for Czechslovakia is used

1. The average annual growth of the TFP from 1998-2000 to 2009-11 has been the fastest in Estonia (Figure 2.21). The TFP growth in Estonia since 1998 has resulted from a boost in both livestock and crop production and reduction of inputs. The growth in livestock production can mainly be attributed to the developments in the dairy sector, whereas the rise in crop production is the result of an increase in cereal and oil seed yield and the expansion of the sown area. Together with increase in production, the use of pesticides and direct on-farm energy consumption have increased. Kimura and Thi (2013) found that large farm size was a factor of high economic performers for most types of farms across countries[[5]](#footnote-6). Farm size dominated other factors in dairy and field crop farms, indicating a potential gain from economies of scale. Other relevant factors of high performance included younger age, higher educational attainment of the main operator, and the use of financial leverage. The analysis identified the adoption of organic practice in less favoured areas as one of the main factors of high performance.

Figure 2.21. Total factor productivity index, 1998-2000 to 2009-11 (1992=100)

Source: USDA, Economic Research Service, Agricultural Productivity Database

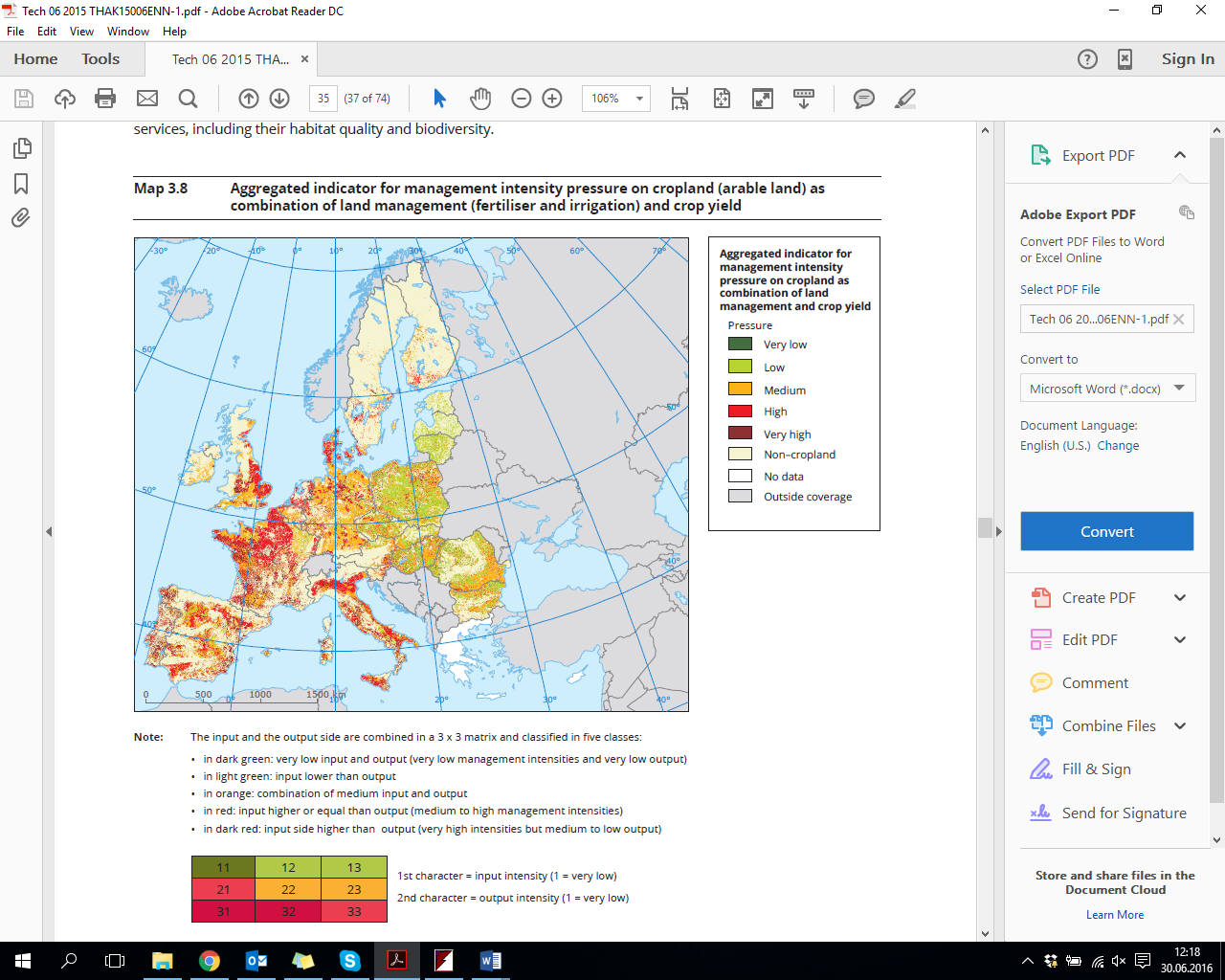
1. The TFP index is calculated on the basis of total production, and the inputs used (Figure 2.22). In Estonia, the total output and the inputs used had declined from 1992-2002. Since 2002, the total output has increased, whereas the inputs have continued to decrease, and this has led to the TFP growth. Despite the fact that productivity growth in Estonia has been very fast, the intensity of meat and cereal production is still not comparable to that of the EU15. Thus, in the coherent assessment of Estonian agricultural sector, it is, in addition to the TFP growth, essential to take into account the (lower) environmental pressure (due to less intensive production) as compared to other EU member states.

**Figure 2.22. Trends in the TFP of Estonian primary agriculture, 1966-2012 (1992=100)**

Source: USDA, Economic Research Service, Agricultural Productivity Database, Agricultural TFP Growth

### Trends in natural resource use and the state of the environment; the main issues regarding sustainable and efficient use of natural resources and other inputs affecting the environment; their measuring and monitoring

1. The abundance of natural resources in Estonia per capita is higher compared to densely populated European countries. In comparison with other Central and Eastern European countries, the intensity of agriculture is lower (Figure 2.23), the state of agro-ecosystem condition ranges from good to favourable (based on EEA technical report No 6/2015). Still, there are regions that need further attention in order to manage agricultural and water resources in sustainable manner, in particular the Nitrate Vulnerable Area in Central and North-Eastern Estonia.

**Figure 2.23 Aggregated indicator for management intensity pressure on arable land as combination of land management (fertiliser and irrigation) and crop yield.** 

Source: EEA (2014)

1. Agricultural area in Estonia was 1,367,957 ha in 1993. During the transition, agricultural area declined to 698,000 ha in 2002. In 2003, during declaration of land to agricultural land registers, 1,215,127 ha were declared. (Seeder, 2013) After the EU accession, the agricultural policy has provided incentives to re-use agricultural land abandoned during the transition. Therefore, the increase in agricultural area has occurred on the account of land that was agricultural before the transition started in the beginning of 1990-s. From 2004-15, area of arable land increased by 28.9% to 669,665 ha (Table 2.13). Area of agricultural land not used for agricultural production but maintained in GAEC increased by 469.6% to 125,053 ha. The area of orchards decreased in this period by 60.4% to 5,866 ha. Area of permanent grassland decreased by 18.6% to 192,295 ha. Agricultural land use under certified organic crop management increased from 2004-15 by 271.2% to 170,797 ha. (Eurostat; WBG, 2015; SE, 2016)

**Table 2.13. Agricultural land use in Estonia, ha**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2004 | 2009 | 2015 | Change from 2004-14, % |
| Agricultural land total | 792,409 | 931,776 | 993,595 | 23.0 |
| ..arable land | 519,348 | 596,413 | 669,665 | 24.8 |
| ..fruit and berry plantations | 14,830 | 8,108 | 5,866 | -58.2 |
| ..permanent grassland | 236,277 | 195,381 | 192,295 | -16.4 |
| ..land not used for agricultural production but maintained in GAEC | 21,954 | 131,874 | 125,053 | 457.5 |
| Arable land per person, hectares per person | 0.38 | 0.45 | 0.51 | 28.9 |
| Organic agricultural land | 46,016 | 95,167 | 170,797 | 243.7 |

Source: SE, 2016; WBG, 2016

1. Although the area under organic agricultural land has increased considerably, the productivity indicators for organic crop and animal production remain lower than those of conventional agriculture. As the average of 2012-14, the crop yields of organic wheat and conventional wheat amounted to 1.94 and 3.92 t/ha respectively. During the same period, the average annual milk yields per cow in organic and conventional holdings were 6,225 and 7,992 kg. (FADN, 2016) In view of the fact that the share of organic production is increasing, whereas the crop yields and the productivity of dairy cows in case of organic farming remain at a lower level as compared to conventional agriculture, the long-term impact of the increase in the share of organic production on the total agricultural output (on the basis of quantities) in Estonia could be negative. To achieve the same levels of production as in conventional farming, more land and cattle must be used, which means that the relative negative environmental impacts of agriculture (e.g., GHG emissions) per one kg of produce may increase.

|  |  |  |
| --- | --- | --- |
| Box 2.5. Development and regional distribution of organic farming in Estonia The area of organic land in Estonia has increased considerably: from 4000 ha in 1999 to 170 797 ha in 2015 (figure 2.24). The share of organic land in total agricultural area was 17% in 2015, compared to 8 % in 2006. Based on the EEA data the share of organic land in 2012 was 18.6% in Austria, 16.8% in Sweden, followed by Estonia (14.8%) and Czech Republic (13.1%). For comparison the share of organic land in Latvia was 10.6%; in Finland 8.3%; in Denmark 7.3%; Poland 4.6%; Netherlands 2.6% (EEA, 2014).  The average size of organic farms in Estonia has increased from 67 ha in 2006 to a current average area of 105 hectares. Even if traditionally organic farms have been small-size family farms, eleven of Estonia’s largest organic farms manage organically over 1 000 hectares of land. The number of organic farms (1 629) was 18-fold in 2015 compared to 1999 (89 farms).  For farms that are in conversion to organic farming 10% higher support rates are paid for up to the first two years starting from 2015. There were ca 1000 farms applying for the organic farming conversion support in 2014. In 2015 organic farming subsidies were applied for by 1 432 applicants (that is 87.9 % of all organic producers), 381 continued the RDP 2007–2013 organic production obligation, 1051 were new applicants for organic subsidies. The share of land in conversion was 14.8% in 2015, 12.4% in 2014.  **Figure 2.24. Area of organic land and number of organic farms 1999-2015**  Source: MRA (2016)  Majority of organic farms in Estonia are located in regions with traditionally extensive agriculture (figure 2.25), that has been a result of less favourable natural conditions, incl. soil properties, water regime, relief. The biggest number of organic farms in 2015 was in Võru (196) and Saare (178) counties. The largest amount of organic land is in Saare (19 251 ha) and Lääne (18 781 ha) counties, where more than 30% of agricultural land is managed organically. The features of land in these counties are small size fields, low nutrient content and stony soils with sandy and clay texture; high share of semi-natural habitats on waterfront pastures and other areas with excessive moisture. The largest share of organic land is in Hiiu county (more than 70%; 10 711 hectares in 2015), that is an island with thin layer of sandy soils and small fields. The smallest share of organic land in total land use (6-7%) is in the counties with high soil quality class: Järva (4807 ha); Lääne-Viru (6888 ha); Jõgeva (5750 ha) (MRA 2016…., ESA 2016).  **Figure 2.25. Location of organic farms (a) and organic land (b) by counties in Estonia in 2015**   |  |  | | --- | --- | | (a) | (b) |   Source: MRA 2015 |

1. Agricultural production in Estonia has concentrated into larger holdings and become more intensive compared to the end of the 1990-s. The share of land used for intensive agricultural practices in 2004 was 7.6%; in 2012 8.7% and has increased to 9.6% in 2014 [KK81]. Agricultural output has increased but at the same time, some of the agri-environmental indicators have declined in the period from 2004-14. The yields of field crops have increased significantly. This could be associated to increased application rates of mineral fertilizers and pesticides. However, the application rates remain lower as compared to Central- and Western-European countries. The number of agricultural animals has decreased, and as a result, the manure production and application on fields has declined. From 1992-97, the application rate of organic fertilizers per fertilized ha decreased by 53% from 59 to 28 tonnes. At the same time, the agricultural area, that was fertilized with organic fertilizers decreased by 26% from 122,000 to 90,000 ha.
2. In the period of 2004-12, the N balance per ha of agricultural land has been positive and P balance has been negative (Table 2.14). During the years 2010-12, the N surplus increased. Annual average increase from 1998-2000 to 2010-12 was 3.8% (Figure 2.24). N balance increased also in the EU15, EU28, Canada, the Czech Republic, Latvia and Poland. In the Netherlands, Denmark, Finland and the OECD countries on the whole, the change in average N balance was negative. P balance per ha of agricultural land has been negative throughout the whole period, with decreasing trend (from 1998-2000 to 2010-12, it decreased by 5.1% annually), making the P status of agricultural soils unfavourable. The average annual change of the P balance was negative in the OECD countries (-9.9%), EU28 (-7.4%), the Netherlands (-8.7%), Czech Republic (-198.3%), Denmark (-6.8%) and Finland (-6.7%). In the EU15 it was positive (1.4%). In Canada and Latvia the average change of P balance was positive (25% and 6.0% respectively) because the deficit is being reduced. Long-term P deficits can lead to a decline in both soil fertility, as well as productivity. Soil management techniques, such as manure and fertiliser application or soil cultivation practices affect the loss of P from agricultural soils. Since less P is needed for plant production, compared to N, less attention is paid by farmers to provide adequate P input. P balance varies with support schemes that the farmers participate in. In case of enterprises benefiting only from Single Area Payment Scheme, the P balance was negative in two years over the 11-year period of 2004-14. In case of enterprises receiving support from Environmentally Friendly Management scheme in eight out of 11 years, whereas in case of organic farms the P balance was negative for all the years under surveillance. Taking into account that the area under organic farms and farms supported from the Environmentally Friendly Management scheme is expanding, the P deficit is expected to increase. (ARC, 2016a; ELF)

**Table 2.14. Nitrogen and phosphorus balances**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2004 | 2009 | 2012 | Change from 2012-14, % |
| N balance (inputs minus outputs), tons | 28,794 | 23,306 | 26,759 | -7.1 |
| N balance per hectare of agricultural land, kg/ha | 36.3 | 25.0 | 28.0 | -22.9 |
| P balance (inputs minus outputs), tons | -3,641 | -5,583 | -5,890 | -61.8 |
| P balance per hectare of agricultural land, kg/ha | -4.6 | -6.0 | -6.2 | -33.9 |

Source: SE, 2016

1. The area of soils potentially affected by water erosion in Estonia is estimated to be 105,800 ha (ca. 2.7% of the territory), mainly in South and South-Eastern Estonia (Mullateadus, 2012). Based on Köster et al. (2008), only 0.75% of all agricultural land was under cultivation on eroded soils. That means that approximately 7,200 ha was used for growing field crops on these soils. The rate of wind erosion is not considerable. Based on the climate conditions of 30 years and erosive days per year, the wind erosion in Estonia is estimated to be small. According to the European map of wind erosion susceptibility there are 0.5-1.0 erosive days per year in West coast areas and North-Eastern Estonia, where the wind erosion risk is higer compared to the rest of the country. The total area potentially affected by wind erosion is estimated to be 104,173 ha. About 33,875 ha of this area was used in crop rotation in 2009 (Mullateadus, 2012). Erosion of >6 t/ha/year does not occur in Estonia. Wind erosion less than 6 t/ha/year can occur at less than 16.1% of arable land. Water erosion of less than 6 t/ha/year appears at 5.4% of arable land. (ENR, 2016)
2. Like most EU transition economies, Estonia revealed a strong growth in pesticide purchases over the 2000-s compared to 1990-s when in many cases the sales declined due to structural transformation and deteriorated terms of trade. From 2004-13, the total sales of pesticides in kg of active ingredients have increased by 62.8% (Table 2.15).

**Table 2.15. Pesticides’ sales**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2004 | 2009 | 2013 | Change from 2004-13, % |
| Total sales of pesticides, kg of active ingredients | 350,870 | 407,189 | 571,286 | 62.8 |
| .. fungicides and bactericides, kg of active ingredients | 34,317 | 40,661 | 64,133 | 86.9 |
| .. herbicides, kg of active ingredients | 284,562 | 327,222 | 434,251 | 52.6 |
| .. insecticides and acaricides, kg of active ingredients | 2,817 | 15,471 | 21,575 | 665.9 |
| .. plant growth regulators, kg of active ingredients | 29,084 | 20,352 | 47,410 | 63.0 |
| .. other pesticides, kg of active ingredients | 90 | 3,483 | 3,918 | 4,253.3 |

Source: SE, 2016

1. The largest amounts of pesticides are used for treating cereals (63.3% in 2013) and industrial crops (27.8%), mainly rape and turnip rape. The rapid increase (ca 72%) in the sown area of industrial crops had influence on the demand for acaricides and insecticdes (the share of usage was 57.7% in 2013). The use of pesticides increased in Estonia during the period from 1998-2000 to 2008-10 on average 8.0% annually (Figure 2.28), at the same time the use of plant protection substances increased also in the EU15 (8.7% annually), the Czech Republic (2.1%), Denmark (1.5%), Finland (3.9%) and Poland (8.5%). On average, the use of plant protection substances in the OECD countries decreased by 8.4% annually, also in the Netherlands and in Canada less pesticides were used during the period of 2008-10 than during the period of 1998-2000. Pesticide use per ha of arable land and permanent crops was 0.6 kg/ha in Estonia on the average of 2005-09. That is considerably lower compared to the Netherlands (8.8 kg/ha) and Germany (2.3 kg/ha) and comparable to the usage in Denmark (1 kg/ha) and Finland (0.7 kg/ha) (FAO 2013).
2. Estonia has sufficient freshwater reserves (Table 2.1). Water use in agriculture primarily depends on weather conditions (temperatures, precipitation) but also on the economic changes and changes in production practices.In the last decade, increasingly fewer pollutants have reached the water environment and atmosphere each year; air pollution has also decreased. During the period from 1998-2000 to 2010-12, the water consumption in Estonian agriculture decreased on average by 16.0% annually (Figure 2.26). The climate (precipitation) in Estonia generally favours crop cultivation. In agriculture, the quantity of water used is mostly related to the production volumes of field crops, fruit trees and berries and, in addition, to watering animals in livestock production. Before the restoration of independence, Estonia could be considered a country with intensive agricultural production, but since the 1990-s changes have taken place in agriculture, which have led to a decrease in the use of water. E.g., from 1990-2015 the area under orchards and berry gardens decreased by 43% (from 11,500 to 6,600 ha) and the area under potato crops 7.8 times (from 45,500 to 5,800 ha). A significant decline could also be observed in the number of farm animals: cattle numbers dropped by ca. 3 times (from 757,800 to 256,200 heads, including the number of dairy cows from 280,700 to 90,600), the number of pigs decreased ca. 2.8 times (from 859,900 to 304,500 heads), that of sheep and goats by ca. 35% (from 139,800 to 90,900 heads), and the number of poultry ca. 3 times (6,536,500 to 2,161,800 heads). Due to the decrease in agricultural activity, water utilisation in agriculture decreased from 41,2 million m³ in 1991 to 4,9 million m³ in 2013. However, it is possible that larger farms may anticipate some problems with water with regard to more stringent legislative restrictions and compliance obligations in the future. (KK15, Metsur, Valdmaa, 2005, PM03, PM06, PM09) The average change of water consumption of Canada and the OECD countries was also negative, indicating that the water consumption in agriculture has generally decreased, in spite of the fact that in the Netherlands, the Czech Republic, Denmark and Poland water consumption has increased as compared to the period of 1998-2000.

**Figure 2.26. Agri-environmental indicators in Estonia in the period 2004-2012**

Source: SE, 2016.

1. Estonia is rich in groundwater resources: the internal renewable groundwater resources are estimated at 4 000 million m³/year. The internal renewable surface water resources are estimated at 11 712 million m³/year. (AQUASTAT, 2016) The total available renewable freshwater in 2014 was 14%, gross freshwater abstraction has increased by 17% since 2000 and was around 1310 m3 per capita in 2014, which is one of the highest levels in the OECD (OECD, 2016d). In 2014, total water withdrawal was estimated at 1720 million m³. Around 88% of total water withdrawal is withdrawn from surface water, 3% from groundwater and 9% from mining water (AQUASTAT, 2016). Five million m³ (0.3%) of total water withdrawal is withdrawn for agricultural purposes – including irrigation, livestock watering and cleaning, forestry and aquaculture). The agricultural water usage has decreased in the last decades mainly caused by the decrease of agricultural activities (MoE, 2016e). The majority of freshwater bodies are in good status. Around 70% of surface water bodies had good ecological and chemical status. Groundwater quality is also good, with more than 90% of bodies having good chemical and quantitative status. All coastal waters (around 16% of the total area of water bodies) are failing to achieve good status. They are affected by eutrophication due to nutrient loads from diffuse and point sources. (OECD, 2016d). The irrigation area decreased from 14,000 ha in the end of the 1970s to 3,680 ha in 1995. Area was mainly located in the North and East of the country. In 2010, the total area equipped for irrigation was estimated at only 458 ha, of which 326 ha were actually irrigated. Drainage is more important than irrigation in Estonia. It is estimated, that without drainage about 2/3 of the land for agricultural production would suffer from waterlogging. In 1975, about 390,000 ha of agricultural land were drained. In 1995, about 732,400 ha, or almost 85% of the cultivated land, are drained, of which 650,000 ha, or 89%, are equipped with subsurface drainage systems. (AQUASTAT, 2016)
2. The farmland bird index shows that the overall population of farmland birds (including the overwintering farmland birds) has decreased, especially rapidly from 1993-95 and from 2007-10 (Kuresoo et al., 2011). There was increase of the national farmland bird index from 1995-2001 (Figure 2.27). According to the long-term (1988-2012) monitoring data, the population of farmland birds has decreased. The number and status of birds is the highest in organic farming areas. This is probably caused by the prohibition of mineral fertilizers and pesticides, thereby increasing the birds’ food supply. At the same time there were no significant differences between areas applying support for environmentally-friendly management or only for single area payment scheme support. (MoE 2015)

**Figure 2.27. Farmland bird index in Estonia, 1990-2012, 2000=100**

Source: SE 2016.

1. The TFP of Estonian agriculture increased on average 4.0% annually during the period from 1998-2000 to 2009-11 (Figure 2.28). The agricultural production volume increased on average 1.8% annually during the period from 1998-2000 to 2011-13. The use of agricultural land area decreased annually by 0.4% on average. The average use of agricultural land area in OECD countries decreased annually by 0.5 percentage points, in the EU15 it decreased on average by 0.4% annually and in the EU28 the average decrease was 0.6% annually. Similar decrease of agricultural land area was in the Netherlands and in Canada. The most visible reduction could be seen in Poland (annual reduction 1.8% on average), but in Finland and in Latvia the use of agricultural land increased.

**Figure 2.28. Average annual change of TFP (1998-2000 to 2009-11), agricultural production volume and agricultural land area (1998-2000 to 2011-13), N and P balance (1998-2000 to 2010-12) in international comparison, %**

Source: OECD Agri-environmental Indicators (2013), Eurostat for Nitrogen and Phosphorus balance for EU countries (2015). USDA Economic Research Service Agricultural Productivity Database for Total Factor Productivity.

1. Input intensity of Estonian agriculture has increased. From 1998-2000 to 2008-10, direct on-farm energy consumption has increased in Estonian farms on average 3.5% annually (Figure 2.29). Increased energy consumption can be result of the shift of production from labour intensive small farms to capital intensive larger farms. Also in Finland, the direct on-farm energy consumption increased. The average direct on-farm energy consumption of the OECD countries, the EU15 and the Netherlands, Canada, the Czech Republic, Denmark and Poland decreased

**Figure 2.29. Average annual percent change of water use (1998-2000 to 2010-12), pesticide use and direct on-farm energy consumption (1998-2000 to 2008-10) in international comparison, %**

Source: OECD Agri-environmental Indicators (2013); OECD Environmental Database (2015) for water use.

1. In 2013, the emission of GHG was in total 21 424.9 kilotonnes in CO2 equivalent, taking into account the use of land, the change of land use and the emissions of forestry (without forestry it was 21 754.9 kilotonnes CO2 eq). As compared to 1990, the GHG emissions CO2 eq decreased by 45.7%. Most of the GHG emissions (90.3%) are made up by carbondioxide (CO2), 5.1% was formed by methane (CH4) and 3.6% by nitrous oxide (N2O). F-gases make up 1.0% of the total emissions. The main source of GHG emissions in Estonia is the energy sector, in 2013 this sector produced 87.6% of total GHG emissions, followed by agriculture (5.8%, totalling 1 254.05 Gg CO2 eq (Figure 2.30)), industry (4.9%) and waste products (1.7%). (Estonian NIR, 2015)

**Figure 2.30. Total agricultural CO2 eq emissions and share of agricultural CO2 eq emissions of total GHG emissions (with and without LULUCF, with indirect CO2)**

Source: Estonian NIR (2015; 2016)

1. Agricultural GHG emissions consist of CH4 emissions from enteric fermentation of domestic livestock, N2O emissions from manure management systems, direct and indirect N2O emissions from agricultural soils, CO2 emissions from liming and urea application to agricultural soils. Direct N2O emissions include emissions from synthetic fertilizers, emissions from animal waste, compost and sludge applied to agricultural soil, emissions from crop residues, cultivation of organic soils and mineralization associated with loss or gain of soil organic matter and emissions from urine and dung deposited by grazing animals. Indirect N2O emissions include emissions due to atmospheric deposition and leaching and run-off. Emissions from enteric fermentation of livestock and direct emissions from agricultural soils were the major contributors to the total emissions recorded in the sector (44.3% and 35.0%, respectively, in 2013). Emissions from the agricultural sector declined by 52.8% by 2013 compared to 1990, mostly due to the decrease in the livestock population and quantities of synthetic fertilizers and manure applied to agricultural fields. The general influence of other sectors influenced by the land use, the change in land use and forestry decreased by 329.97 kilotonnes CO2 eq. (Estonian NIR, 2015)
2. During the period from 1998-2000 to 2008-10, the agricultural GHG emissions in CO2 eq decreased in Estonia on average 0.1% annually (Figure 2.31). The decrease of emissions in the OECD countries was 0.5% annually and in the EU15, 1.0% annually. The largest reduction of GHG emissions was in the Netherlands (on average 1.7% annually, although in the Netherlands the number of livestock increased in 2004-13 (FADN)), as well as in the Czech Republic (on average 1.1% annually, the number of animals in the Czech Republic decreased in 2004-13, except for non-dairy cows, and sheep and goats (FADN)) and in Denmark (on average 1.1% annually, the number of farm animals, except for sheep and goats, increased in 2004-13). In Canada and Finland, the GHG emissions increased as compared to the period of 1998-2000. In Finland, the number of farm animals (except poultry) increased in 2004-13. Over the same period, livestock numbers (except pigs) increased in Estonia as well (FADN). The low-income EU member states are not obliged (for now) to reduce emissions in sectors excluded from the emissions trading system (buildings, transport, agriculture, waste etc., i.e. in non-ETS sectors). Instead, the increase of emissions should be limited. In these sectors, the EU aims to reduce emissions by 10% compared to 2005. Estonia is obliged to limit emissions in these sectors within 111% of 2005 levels (i.e. in agriculture, it is allowed to increase emissions by 11% by 2020, compared to 2005). According to the EU climate and energy policy framework, Estonia aims to reduce emissions in non-ETS sectors by 11-14% by 2030, compared to 2005 (Government Office, 2014; MRA, 2013c; MOE, 2016).

**Figure 2.31. Average annual change of GHG emissions (1998-2000 to 2008-10) in international comparison, %**

Source: OECD, 2013.

1. Ammonia (NH3) emissions in Estonia have decreased during the period from 1998-2000 to 2008-10 on average by 0.1% annually (Figure 2.32). As compared to 1990, NH3 emissions decreased 2.4 times by 2012 (from 24,000.2 tonnes to 10,137.9 tonnes), which can be explained by a substantial decline in the number of livestock in Estonia (the main share of ammonia emissions originate directly form livestock farming, the emissions from mineral fertilizers are relatively moderate). (EMU, 2008) Most of the ammonia released into the outside air is produced in agriculture: about 94% in 2013; livestock breeding accounts for 68.6%, and the use of N fertilizers is responsible for 25% of the ammonia released into the outside air in Estonia. Other major sources of pollution include road transport, the production of fertilizers and the burning of firewood in households (EEA). In the OECD countries the emission of ammonia has decreased on average by 3.3% annually and in the EU-15 the decrease was on average 1.4% annually. The largest reductions of NH3 are in the Netherlands (on average 3.7% annually) and in Denmark (on average 3.1% annually). In Canada and Finland the NH3 emissions have increased during the period from 1998-2000 to 2008-10 on average by 0.1% and 0.2% in a year respectively.

**Figure 2.32. Average annual percent change of ammonia emissions (1998-2000 to 2008-10) in international comparison, %**

Source: OECD, 2013.

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| --- |
| Box 2.6. Monitoring of agri-environmental indicators in Estonia Information about national agri-environmental indicators are gathered by Statistics Estonia.  The Agricultural Board’s (AB) areas of activity include land improvement, plant protection, plant health, plant variety rights, seed and plant propagating materials, organic farming, fertilizers and horticultural products. The AB organizes the surveillance of plant health, plant protection products, seed and vegetative propagation material and organic plant production (AB).  The Estonian Agricultural Research Centre (ARC) conducts field and laboratory tests (pesticide residues and other contaminants in plant materials and in soils, plant pest diagnoses, agrochemical analyses of soil and fertilizers, microbiological analyses of plant production, seed quality testing etc). The organisation has competency in different areas: soils, seeds, fertilisers, feeding stuffs, grain and grain products, plant product quality and safety analysis, identification of plant diseases and pests, and evaluation of agri-environment measures. It prepares fertiliser and lime consumption cards, carries out research in the field of good agricultural practices and agricultural chemistry (ARC).  The monitoring of the organic processing, catering and marketing is managed by the Veterinary and Food Board (VFB).  In addition to agri-environmental policy measures that are in the responsibility area of the Ministry of Rural Affairs (MRA), the general environmental policy is responsibility of the Ministry of the Environment (MOE), which is responsible for national environmental and nature protection, fulfilling tasks related to land and databases containing spatial data, organising the use, protection, re-production and accounting for natural resources, ensuring radiation protection, performing tasks related to mitigation of effects of climate change, environmental supervision, meteorological observations, nature and marine research, geological, cartographic and geodetic operations, maintenance of land cadastre, organising the use of external tools for environmental protection, as well as compiling strategic documents and draft legislation. (MOE, 2016)  The Environmental Board (EB) seeks to preserve a realistic balance between the use and protection of natural resources. One of its most important tasks in the field of nature conservation is gathering the data it needs to make decisions, including for the organisation of inventories and monitoring. The Information System for Environmental Permits holds digital data about 6 major fields: water, waste, mining, air, complex and climate. There are two web applications built on dataset:   1. for public use Environmental Permits Information System (<https://eteenus.keskkonnaamet.ee/?page=avalik_stat_koond&act=avalik_info>), and 2. for officials Information Technology Centre of the MOE ([www.kemit.ee](http://www.kemit.ee)). |

### Medium to long term projections regarding natural resources and climate change in Estonia, and the projected impacts on future productivity growth

1. Estonia has carried out a number of studies to identify the possible scenarios in relation to different measures beneficial for the environment. Estonia’s GHG emissions will depend, first and foremost, on the share of renewable energy in the energy sector (including transport), as well as on the energy efficiency rate, as in 2013 87.6% of GHG emissions originated form energy industry, the share of emissions from agriculture was 5.8%, and that of industrial processes and waste sector 4.9% and 1.7%, respectively (Estonian NIR, 2015). The estimated GHG emission until 2030 are projected in the Estonian Sixth National Communication, taking into account the policies and measures implemented and adopted within the framework of current national climate policy. By 2030, the GHG emissions are projected to decrease to 16,165 Gg of CO2 eq (a decline of 17.7% as compared to 2013). The forecasts taking account of additional measures (energy efficiency measures involving a decrease in heat and electricity consumption and correspondingly also production; energy saving measures, i.e. making fuel consumption more efficient; increasing the proportion of renewable fuels for transport) foresee a decrease of GHG emissions to 15,797 Gg of CO2 eq (a drop by 19.6%, as compared to 2013). (MOE, 2013b)
2. The study “Estonia’s opportunities to move towards a competitive low carbon-economy in 2050” includes an analysis of the effects of different scenarios concerning further developments in respect of climate policy and projected GHG emissions by 2050. The analysis shows that compared to 1990, it is possible to reduce GHG emissions by approximately 75% (or by 0.3 million tonnes of CO2 eq) to 87% (or to 5.4 million tonnes of CO2 eq) by 2050, which will have a positive socio-economic impact (improvement of the environmental situation, more efficient economy). On the other hand, this brings about an increase in energy prices, which affects both the private households and the economy as a whole. Resource consumption (demand), consumer behaviour (conscious choice) and manufacturing technologies, as well as land use, land-use changes and forestry (LULUCF) play an important role in different scenarios (MOE, 2013a).
3. The climate projections and estimates until 2100 made in the “Estonian National Climate Change Adaptation Strategy and Implementation Plan” are based on the results of climate change projections worked out within the EURO-CORDEX project, the findings of the UN Intergovernmental Panel on Climate Change (IPCC) reports, AR5, AR4, the IPCC special editions SREX, summary of the scientific research BACC (Baltex Assessment of Climate Change in the Baltic Sea Basin) and climate impact assessment made within the project Baltadapt. Compared to the reference period 1971-2000, the air temperature in Estonia is projected to increase by 2.0°C (RCP4.5 scenario) to 2.6°C (RCP8.5 scenario) during the period 2041-70, and during the period 2071-2100 by 2.7°C to 4.3°C, respectively. Both scenarios expect the rise in air temperature to be the highest in spring months, followed by that in winter months. RCP4.5 forecasts the average annual precipitation to rise by 10% from 2041-70 and by 16% in the period 2071-2100, as compared to the reference period. According to this scenario, the rise in precipitation in summer will be the sharpest, whereas RCP8.5 scenario foresees the highest increase in spring precipitation. RCP8.5 predicts a 14% rise from 2041-70 and a 19% rise from 2071-2100, as compared to the reference period. Extreme precipitations (more than 30 mm per day) are also expected to increase, but in view of the very low probability of occurrence for the best part of the year, it is only relevant to the summer.
4. Projections for the 21st century forecast a significant decrease in the snow cover by the end of the century. In the reference period 1971-2000, the number of days with snow cover in April was on the average 1-6. Both RCP4.5 and RCP8.5 scenarios consider the possibility of snow in April very low. RCP4.5 expects the snow cover in March to be more than 10 days shorter as compared to the control period, in case of RCP8.5 projections, even up to 15 days shorter, extending rarely over five days. RCP4.5 forecasts a decline in the duration of snow cover by at least 10 days in January-February, extending on an average to less than 15 days, which essentially means the lack of a persistent snow cover. RCP8.5 predicts that the duration of the snow cover in January-February will, as a rule, be less than 10 days. According to RCP4.5, the predicted extent of sea ice on the Baltic Sea would extend to 75,000 km2 (30,000 km2-140,000 km2) by 2085 and to 45,000 km2 (23,000 km2-70,000 km2) in the case of RCP8.5 as compared to the current average of 115,000 km2.
5. Average wind speed is expected to increase (in the range from 3-18%) in winter and partly also in spring, which is related to an increase in the number of cyclones moving from the Atlantic to Estonia. During the period from 2061-90, sea surface temperatures in the Estonian coastal waters in winter and spring are expected to rise by 2.1-2.8°C and in summer and autumn by 1.0-2.0°C as compared to the reference period 1970-99. Sea-level changes assessment must take into account the average rise in the ocean level, which in case of CP4.5 will amount to 32-63 cm and in case of RCP8.5 to 45-82 cm by 2081-2100. The main hazards related to the rise in sea level are the flooding of coastal areas (with valuable semi-natural coastal meadows (habitats) and grazed and managed pastures, which have historically adapted to flooding), the erosion of sand beaches and the destruction of port and harbour structures. Several valuable natural ecosystems are also threatened, encompassing both marine and mainland ecosystems and including rare plant communities and bird nesting grounds. The water temperature in Estonian lakes could rise by 2-7°C by 2100. The levels of inland water bodies will be lower than at present and more evenly distributed (in addition to spring floods, also autumn floods). It is possible that the four main hydrological periods will be replaced by two, which means a fundamental change in the hydrological regime. Generally, 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. Climate change may induce significant changes in the hydrological regime of near-ground water layer because freshet infiltration into groundwater may increase by 20-40% due to the shortening and warming of the winter period. Owing to climate change, the ratio of the total groundwater recharge to surface runoff will increase from 30% to 40%. (EEA, 2014; MOE, 2013b, MOE 2016; EMU, 2015c)
6. It is difficult to assess the overall impact of climate change on agriculture in Estonia. Climate change will mainly affect plant production and grasslands, whereas the effects may be both positive and negative. Favourable climatic conditions and the continuing EU support may lead to the intensification of agriculture, which is also reflected in livestock farming (due to the significant and increasingly important role of pastures). Upturn in livestock production and the concentration of livestock production within large-scale farmers will result in an increase in the environmental load in certain rural regions, as well as in the GHG emissions in manure management. In the expansion of farming and increasing the role of crop production, it is important to ensure that fields would not be 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 fertilizers, which, in turn, will result in increased direct and indirect nitrous oxide (N2O) emissions from agricultural lands). (MOE, 2013a)
7. Taking into consideration the latitude of Estonia, the positive factors accompanying climate warming will probably dominate at first. In 1965-2013, the overall vegetation period (t>5°C) as well as the active growing season (t>10°C) in Estonia increased by an average of three weeks, primarily due to the last spring frost occurring earlier. The shift was the biggest in South-Eastern Estonia, and less pronounced in North-Eastern Estonia. (ETI, 2015) The increase in temperature and in the volume of precipitation will have a positive effect on 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 0.17 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 accelerates and the suitable time for harvest shifts to an earlier period. This will ensure better fodder for livestock in summer and winter.
8. An increase in the average temperature will lengthen the vegetation period and the sowing and harvest periods. Over the past 50 years, the growing season in Estonia has become considerably longer, especially in spring, allowing to sow a number of crops earlier. The earlier start of the vegetation period in spring contributes to the expansion of permanent grasslands and favours the cultivation of winter crops. These crops start growing as soon as possible, taking advantage of the water supplies accumulated during winter, benefit from the nutrients remaining in the soil from the preceding crops, escape dangerously high temperatures in the key stages of their development and generally have a higher yield potential. In addition, the estimated rise in temperature enables to grow new, heat-loving crops and/or crops with longer growing cycles, introduce more productive varieties, for example, maize could become a widely grown crop. (ETI, 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 help use arable land more efficiently and disperse the workload of agricultural producers. The lengthened vegetation period will additionally allow for the growing of new plant species and varieties in Estonia.
9. Despite the hazards (grazed grasslands will be more sensitive than mown meadows to climate warming that brings about drought periods; an increase in the frequency of extraordinary meteorological phenomena (droughts, excessive moisture, flooding etc.) may reduce yields[[6]](#footnote-7); the spread of plant diseases, plant pests and infectious animal diseases; possible negative impact on the numbers of pollinators (pesticides have a negative effect on the abundance and diversity of pollinators)), Estonian agriculture will most likely be initially more productive and competitive as a result of climate change. (MoE, 2013b; EERC, 2016; EMU, 2015c)

## Summary

* With 0.74 ha of agricultural and 0.49 ha of arable land per inhabitant, Estonia has abundant agricultural land resources. In the longer term, the land and water resources in Estonia are sufficient for contributing to the development of agriculture to meet the demand for food, both in domestic and foreign markets.
* While crop and animal production, hunting and related service activities’ share in GDP was 2.0%, and the manufacturing of food products, beverages and tobacco products’ share in GDP was 1.9% in 2015, in Estonia, the share of agriculture, forestry and fishery in GDP was highest among the selected countries. Only in Poland, agriculture comprised larger share in employment than in Estonia. In Estonia, agricultural and food products comprised 9.8% of the value of exports and 10.7% of the value of imports in 2015.
* Significant restructuring has occurred, resulting in a dual structure with large technically efficient, more input intensive and innovative farms, but also very small farms. In recent years, the speed of decline in number of agricultural holdings has slowed down.
* In Estonia, agricultural output growth has been rapid since the EU accession. The contribution of cereals and oilseeds to agricultural output has increased.
* Labour productivity in agriculture remains significantly lower as compared to Scandinavian and Central-European countries. The productivity gap between agricultural and food industry workers is lower as compared to many other countries, implying higher labour productivity growth in primary production compared to food manufacturing industry.
* Farm consolidation has lead to concentration of livestock production into larger units. The exceptions are beef, sheep and goat farms. However, the average livestock density has declined. Livestock density in large farms exceeds that of the smaller farms.
* Estonia has a dualistic food processing industry structure, but large Estonian food manufacturing companies are smaller than those in other countries. The average turnover of large Danish and Dutch food industry enterprises (>250 employees) exceeded the Estonian figure by 11.8 and 10.9 times, respectively. Dairy processing industry is fragmented, providing wide assortment of products for domestic market, but lacking competitiveness in Baltic raw milk market for producing export products.
* Estonia is a net exporter of raw materials (e.g. cereals and live animals), but net importer of processed products (e.g. products of milling industry, preparations of cereals, flour, starch or milk) and fruits and vegetables. This suggests that the capacity of food manufacturing industry has not developed as quickly as the agricultural output.
* High productivity gains reflect catching up on investment and technology. In recent years it is due to production growth without increasing inputs. Increasing input intensity has contributed to higher productivity and increasing agricultural output. Use of pesticides, mineral fertilizers, and on-farm energy consumption has increased. At the same time, farmland bird index has declined.
* Agriculture’s share in water withdrawal is low in Estonia, as the area of irrigated agricultural land is very small, comprising just 0.04% of UAA.
* CAP, through decoupled are payments has provided incentives for reusing the agricultural land that was left out from production and that was not kept in GEAC during the first phase of transition in the 1990-s. As a result, Estonia’s agricultural area has been on the rise since 2004, increasing by 25.4% (201.2 thousand ha) from 2004-15. Direct payments, environmental area payments of RDP and investment support of RDP have motivated to increase the area of arable land, the area of which has increased by 28.9% (150.3 thousand ha) from 2004-15. The area of land not used for agricultural production but kept in GAEC has increased by 469.9% (103.1 thousand ha) from 2004-15.
* Over the last decade, the area of organic land has increased 3.7 times, and organic farms are becoming larger. The number of organic produce processors is also on the rise, as well as the demand for, and the supply of organic food. An increase in organic food production could lead to an increased need for such agricultural resources as farm animals and farmland, which in turn could cause the deterioration of the soil and a boost in GHG emissions. In case of organic production it is essential to adopt the technologies enabling sustainable organic farming. 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; bumble bee indicators, the diversity and abundance of nesting birds).
* Climate change benefits stem from higher temperature, and farmers will have to adapt to new opportunities, but that could result in higher occurrence or new pests and diseases. Higher water levels are not expected to affect agriculture significantly. Management of pests and diseases will possibly become more prominent challenge with climate change
* In Estonia, GHG and ammonia emissions have not declined as much as in OECD and EU-15 countries. As a low-income EU member state, Estonia is allowed to increase agricultural GHG emissions by 11% by 2020 compared to 2005.

# 3. Economic stability and trust in institutions

## Macroeconomic policy environment

*At the broadest level, stable and sound macroeconomic policies, leading to high growth, and low and stable inflation rates, play an important role in setting a favourable environment for investment in farms or agri-food firms seeking to introduce new products, to adopt new production methods, or to undertake organisational changes that can lead to higher productivity growth and more sustainable use of natural resources. Assessment of the country’s overall growth and growth potential in the short- to medium-term has implications for sector specific prospects as well. In some circumstances, macroeconomic policies and their impacts can contribute to implicit and perhaps unintended biases for or against the food and agriculture system.*

### Overall economic performance and medium term prospects for growth

1. Fast economic growth in Estonia during last 25 years has caused significant structural changes. The competitiveness of Estonian goods and services both in domestic and international market has changed, as well as the structure of foreign trade. Regaining independence in the beginning of 1990-s and the integration of Estonian economy into World economy, the accession to the EU in 2004, and more recently financial crisis have been the main drivers behind the dynamics of competitiveness of Estonian economy.
2. Estonia is a country with small domestic market with only 1.3 million inhabitants, known particularly by openness, liberal trade and investment laws, and balanced state budget. Openness to international trade and investment started after regaining independence in 1991. According to t**he Wall Street Journal and Heritage Foundation’s Index of Economic Freedom,** Estonia ranks as one of the freest economies in the world, being 9th within 178 countries in 2016 (Miller and Kim, 2016). In Fraser Institute’s “**Economic Freedom of the World: 2015 Annual Report”** economic freedom scoreboard Estonia ranks **22nd within 157 countries (**Gwartney et al, 2015**).**
3. Although according to the OECD better life index, Estonia has made progress over the last decade in terms of improving the quality of life of its citizens, still there are only few aspects of well-being where Estonia is performing well compared to industrialised countries. Estonia is performing above the OECD average in education and skills, environmental quality, and work-life balance, but below average in housing, jobs and earnings, subjective well-being, personal security, income and wealth, health status, and civic engagement.
4. Starting from 1990-s, the growth in Estonian economy has been considerable (Table 3.1). In the period from 2001-07 the growth of GDP was very high making Estonia one of the fastest growing economies in Europe. Following the global financial crisis, the Estonian economy experienced a sharp contraction of output in 2008-09. The downturn of economy was reinforced by domestic credit boom in the construction sector and by procyclical fiscal policy (OECD Economic Surveys of Estonia 2011, 2012, 2015).
5. Economic projection of the Ministry of Finance (MOF) from summer 2015 states that due to continuing economic slowdown of the main trade partners, especially in Finland and Russia, the demand for Estonia’s goods and services has been low. Economic growth has been based on domestic consumption in recent years. In addition, the wage income increase has supported consumption-led growth. In recent years, Estonia has witnessed stable price level. Prices of energy and food have been slightly declining. (MOF, 2015b)

**Table 3.1. Estonia’s key indicators of macroeconomic policy**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1995 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015e | 2016e |
| Real GDP growth, % | .. | 9.9 | 9.5 | 2.5 | 8.3 | 4.7 | 1.6 | 2.1 | 2.1 | 3.3 |
| General government financial balance1 | 1.4 | 0.0 | 1.1 | 0.2 | 1.2 | -0.2 | -0.2 | 0.6 | 0.4 | 0.6 |
| General government gross debt2 | 13.3 | 6.8 | 8.2 | 11.9 | 9.5 | 13.2 | 13.5 | 14.3 | 12.9 | 11.4 |
| Current account balance1 | -4.2 | -5.4 | -8.7 | 1.8 | 1.4 | -2.5 | -1.1 | -0.1 | 0.8 | 0.6 |
| Exchange rate, (EUR per USD)3 | 0.7 | 1.1 | 0.8 | 0.8 | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 |
| Unemployment rate, %4 | .. | 14.4 | 8.0 | 16.6 | 12.3 | 10.0 | 8.6 | 7.3 | 6.5 | 6.1 |

e: OECD Economic Outlook estimate.

1As a percentage of GDP.

2As a percentage of GDP at market value

3Period average.

4End of year, as a percentage of total labour force

Source: OECD Economic Outlook No 97 - June 2015 - OLIS version.

1. Statistically, the situation in labour market has also improved, but it is partially due to new regulations on employees’ registry since mid-2014. Employees’ registry has reduced undeclared work and therefore has contributed to the improvement on labour market statistics. The wage growth has exceeded nominal GDP growth rate. Therefore, the profitability of companies has declined, being one reason behind low investments by companies. (MOF, 2015b)
2. The macroeconomic projection by MOF from summer 2015 sees that Estonia’s GDP will grow by 2.6% in 2016 (Figure 3.1). In 2017, expected growth will be up to 3.4%, and after 2017, the growth rate declines to around 3%. Decline of expected growth rate after 2017 is explained by the closure of output gap and decrease in number of employees. Compared to previous proejction, MOF has lowered the growth projection due to continuing recession in Estonia’s major export markets. Therefore, domestic demand remains a main engine of growth. MOF also expects the recovery of investments in coming years. In 2018 and 2019, growth is projected to be 3% and be driven by both domestic and foreign demand. (MOF, 2015b) From Figure 3.1 it appears that the OECD estimate of GDP growth for 2015 is 2.1% what is slightly higher compared to the estimates of MOF (latest estimate 1.7%) and Bank of Estonia (BE) (latest estimate 1.2%). The 2016 growth by MOF is estimated 2.6% and BE estimate is 2.2%. Both of these 2016 estimates are more conservative compared to the OECD estimate of 3.3%

**Figure 3.1. Projections of Estonia’s economic growth for 2016 according to publication date**



Source: MOF (2015b)

1. According to BE, potential growth has been below expectations for long-term growth. BE emphasises that the major reason behind low growth rates are structural and these are not expected to change in the short-term. An example of such structural reason is the decline in exports to Russia. These exports are not likely to recover in short-term and redirecting these exports is difficult. In addition to structural reasons, low growth rate is also associated to a low investments rate compared to previous years. Projection of BE states that faster growth depends mostly on potential growth in the future, but GDP will remain below its potential and there are unused resources in the economy. As the potential growth has been low in recent years, the future potential growth will be driven by TFP growth. By estimation of BE, TFP growth has been modest because of the crisis and following years of recession. (Bank of Estonia, 2015)
2. The general government budgetary surplus is estimated to be 0.4% of GDP. Surplus was achieved due to increased tax receipts and dividends from financial sector. Contrary to OECD estimate (surplus of 0.6%), MOF estimates 2016 central government budget to be in deficit by -0.2% and is expected to be in surplus again in following years. (MOF, 2015b)
3. Estonia is known as a country with very low general government gross debt. As stated by the MOF the goal is to proceed with a sustainable fiscal policy. The budgetary objectives are concerned with a general government structural surplus, strict fiscal policy and low level of government debt. The priorities in State Budget Strategy bring forward reduction of tax burden of labour and sustainable public finance. (MOF, 2015)
4. Current account surplus is projected to increase in 2015 and 2016 (Table 3.1), but is expected to decline in the following years. (MOF, 2015b; Bank of Estonia, 2015)
5. Estonia is a member of Eurozone, adapting euro in 2011. Comparing the trade structure of Estonia with exchange rate development, there are two groups of trading partners. One group from continental Europe, who have floating currencies against euro, and the other group using US dollar. While euro has weakened against US dollar, it has strengthened against the currencies of mentioned continental trading partners. As estimated by BE, the composition of the Estonian export markets implies that that the depreciation of the euro against the dollar has little impact on trade while the nominal effective exchange rates have strengthened over all foreign partners combined. (Bank of Estonia, 2016)
6. The World Economic Forum (WEF) Global Competitiveness Indicators (GCI) for 2015-16 rank Estonia at the 30th place (previously 29th) within 140 countries. Estonia is considered an innovation driven economy. Notably better has Estonia performed in macroeconomic environment (3rd pillar) and labour market efficiency (7th pillar). Estonia ranks 15th in both of these pillars. Even though the overall performance is very good, Estonia lacks from market size and business sophistication. (WEF, 2015)
7. Estonian companies rank 43rd in business sophistication and 29th in innovation. In business sophistication, companies are not successful in having broad presence in the entire value chain; rather they are involved in individual steps of the value chain. Estonian companies are not very successful in using marketing to differentiate their products. The nature of competitive advantage is still in low-cost labour or natural resources. From innovation side, two things stand out. Very low availability of scientists and engineers for companies from one side (rank 73) and high level of government procurement of advanced technology products (rank 20). In international comparison, Estonia still ranks as innovation-driven economy.
8. Educational system in Estonia is one of the factors enhancing position in GCI rankings. Health and primary education (rank 22) and higher education and training (rank 20) support competitiveness and are ranked very high. Financial market development is considered very high (rank 23), especially the trustworthiness and confidence of the financial market. Both, goods and labour markets (ranks 22 and 15, respectively) are very efficient. Estonian labour market is considered very flexible. In spring 2014, BE and TNS Emor carried out a survey of Estonian employers on how Estonia adjusts to economic changes in comparison to other countries, how flexible is wage-setting in Estonia, and what effect the major labour market reforms passed during the crisis had. One of the interests in survey were the barriers to the recruitment of new employees. The biggest barrier to recruitment was the shortage of qualified labour. Shortage of qualified labour was considered serious by 90% of the employers. As obstacles to recruitment were also notable high labour taxes and high wages. But only 36% of employers considered the costs of firing and hiring to be a barrier. Most employers in Estonia see labour market as flexible. (Soosaar, 2015)
9. Both public and private institutions are considered very well developed and very reliable with combined ranking 25th. The quality of infrastructure has slightly weaker position (rank 33). The biggest disadvantage is in air transportations where both quality of air transport infrastructure and availability of airlines is very low. In addition, the quality of roads is low. Estonia ranks very high only in maritime transport infrastructure (see also Chapter 5).
10. Third pillar of macroeconomic environment consists of indicators, which are considered important for business and are significant for the overall competitiveness of a country. Compared to other pillars of CGI, the macroeconomic environment ranks very high (rank 15). In 7-point scale Estonia scores 6.2. Compared to the OECD average (5.2) Estonia is one of the best performers lagging only slightly behind the OECD top 5 (6.5) (Figure 3.2). Estonia ranks on top in inflation (though the reasons behind the low levels of inflations are not stemming from competitiveness but more from continuing recession in economy). Estonia has been known for years now for its low levels of government debt and ranks 6th in government debt as a % of GDP rankings. The level of gross national savings (rank 37) is comparable with advanced economies and government budget balance (rank 18) is indicating surplus. (WEF, 2015)

**Figure 3.2. Global Competiveness Index: Macroeconomic environment, 2015-16**

Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Norway, Korea, Switzerland, Denmark and Luxembourg). Indices for EU28 and OECD are the simple average of member-country indices.

Source: World Economic Forum, The Global Competitiveness Report 2015-2016.

1. According to WEF survey, the most problematic factors for doing business were inadequately educated workforce and tax rates. Great obstacles to business were also access to financing, inefficient government bureaucracy and insufficient capacity to innovate. (WEF, 2015)
2. Global Entrepreneurship and Development Institute (GEDI) with Estonian Development Fund (EDF) carried out survey in 2014, to analyse and identify the problems of entrepreneurial performance. The main findings in this report were Estonia ranks 21st (within 120 countries) in the global ranking of entrepreneurship ecosystems and that Estonia ranks high compared to its GDP per capita. Most important obstacles to entrepreneurial performance were innovation, finance, attitudes towards, and skills for entrepreneurship. (GEDI, 2014)

### Government measures for promoting economic growth and jobs

1. The National Reform Programme “Estonia 2020” was approved in 2011. It indicates the objectives for 2015-20 to improve competitiveness. There are two main objectives: 1) increasing the productivity, and 2) enhancing employment. In the program, the main focus is on education and employment, with an emphasis on integration of long-term and young unemployed people in the labour market and on the development of their skills. (Government Office, 2014).
2. Strategic planning in Estonia is governed by the State Budget Act and by Government Regulation No. 302 dated 13 December 2005. In this regulation, the types of strategic plans developed by the ministries are stated. Development plans are divided into two broader categories: 1) sectoral plans, which are typically coordinated by the responsible ministry, and 2) organisation-based development plans that include the area of a ministry or government.

### Ways how macroeconomic fundamentals facilitate or discourage investment and trade, including in the food and agriculture sector

1. Estonia has been leading country in Central and Eastern Europe considering inward foreign investments, even though that Estonia has very small domestic market. Estonia is known particularly by openness, liberal trade and investment laws, and balanced state budget. Economic growth since the early 1990-s has been considerable (see table 3.1). General government gross debt has been very low and in most years government has run budget surplus. Current account balance as a percentage of GDP has declined and fluctuates between small deficit and surplus. Though the surplus of past years is mainly due to the global economic slowdown. Unemployment rate is high but lower than in most European countries. The growth perspectives are still below expectations for long-term growth because of the low growth rates among major trading partners. Lower investments rates compared to previous years are also mainly because of the global economic slowdown.

## Governance and quality of public institutions

*Good governance systems and high-quality institutions provide economic actors with the assurance that the government is accountable, transparent and predictable. They are a fundamental pre-condition both to encourage public and private investment in the economy and to enable those investments to achieve the intended benefits, both for investors and the host country. Moreover, governance systems play an important role in addressing market failures, influencing the behaviour of firms in terms of investment and compliance to regulations, as well as the efficient functioning of farm input and output markets. Finally, how the environment and natural resources are part of the institutional framework and public decision making is important in the capacity for designing efficient and acceptable policy tools.*

### Transparency, clarity and predictability of governance rules, institutions and regulatory process

1. Estonia has transformed from a centrally planned economy to market economy. During the transformation process, the government followed the policy of openness to world markets and maintaining balanced budget and low level of government debt. As the OECD Public Government review from 2011 states, Estonia has developed all the necessary functions and apparatus of modern state. However, there are number of challenges starting with continuing economic slowdown, worsening demographical situation and growing regional disparities. Policy of openness has improved competitiveness, but has also made economy more vulnerable to external shocks. Nevertheless, the OECD review states that Government of Estonia has been quite effective in state building and becoming as a model for small open economies. (OECD Public Government review, 2011)
2. An important conclusion from OECD analysis is that in the post crisis period, Estonia has showed good progress in developing further a single government approach with greater administration from the Cabinet of ministers, constrained financial management and stronger governance and accountability frameworks. Still there is strong evidence of an importance of informal networks and practices. (OECD Public Government review, 2011)
3. The quality of public institutions is considered as very good (Table 3.2) according to World Bank’s Worldwide Governance Indicators (WGI). The WGI define governance as the traditions and institutions by which authority in a country is exercised. WGI measures six broad aspects of governance: voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption. Voice and accountability indicates how citizens are able to participate in selecting their government, freedom of expression and association, and a free media. Here Estonia ranks very high, slightly below OECD average. Lowest percentile rank is in political stability and highest in regulatory quality. (WGI, 2015b)

**Table 3.2. Percentile rank (0 to 100) of World Governance Indicators for Estonia, 2014**

|  |  |  |
| --- | --- | --- |
|  | Estonia | High income:OECD |
| Voice and accountability | 85 | 87 |
| Political stability | 72 | 77 |
| Government effectiveness | 81 | 88 |
| Regulatory quality | 93 | 87 |
| Rule of law | 86 | 88 |
| Control of corruption | 87 | 85 |

Source: WGI, World Bank

1. According to WEF GCI, Estonia ranks very high in quality of public institutions (Figure 3.3). Estonia ranks above OECD average in all categories of public sector quality, and performs very well in security. Security is indicating very low level of organized crime (rank 9), business costs of terrorism, crime and violence. In ethics and corruption, the overall rank is 25, showing that illegal diversion of public funds, irregular payments and bribes are not common. However, Estonia is lacking somewhat behind in public opinion about ethical standards of politicians. Concerning undue influence, Estonia ranks also very high (rank 21), meaning that the judicial system is independent from influences of the government, individuals, or companies, and that government officials show little favouritism when deciding upon policies and contracts. Government efficiency ranks 22 meaning high efficiency of government spending and low burden of government regulations, though Estonia has lower efficiency of the legal and judicial system for companies in settling disputes. The overall rank of Estonia in the quality of public institutions is 25. (WEF, 2015)

**Figure 3.3. Global Competitiveness Index: Quality of public institutions, 2015-16**

Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Finland, New Zealand, Luxembourg, Switzerland and Norway). Indices for EU28 and OECD are the simple average of member-country indices.

Property rights refers to the average of the indices Property rights and Intellectual property rights. Ethics and corruption refers to the average of the indices: Diversion of public funds, Public trust in politicians and Irregular payments. Undue influence refers to the average of the indices for: Judicial independence and Favoritism in decisions of governmental officials. Government efficiency refers to the average of the indices for Wastefulness of government spending, Burden of government regulation, Efficiency of legal framework in settling disputes, Efficiency of legal framework in challenging regulations and Tranparency of government policymaking. Security refers to the average of the indices for: Business costs of terrorism, Business costs of crime and violence, Organized crime and Reliability of police services.

Source: World Economic Forum, The Global Competitiveness Report 2015-2016.

### Protection of investors, innovators, and the host society; equality of application in regions, including rural areas, and concerning people

1. According to GCI scores, property rights, including financial assets and intellectual property rights are well protected. Based on business opinion surveys, Estonia ranks 28 in property rights protection. Compared to OECD average, Estonia has higher score in property rights protection. (WEF, 2015)
2. OECD Public Government review from 2011 brings out that national and sub-national administrative structures, problems in territorial management and relations between different levels of government hinder efficient delivery of public services of equal quality across the territory. However, there are also some advantages in territorial context. Namely, relatively even distribution of working-age population across the territory and that Estonia’s competitiveness should include the potential of the whole territory. (OECD Public Government review, 2011)

### Representation of environmental and natural resources concerns in the institutions and decision-making process

1. An example of natural concerns in the institutions and decision making process is the project aiming to improve environmentally sound public procurements (<http://www.envir.ee/en/improving-environmentally-sound-public-procurements>). In 2009, a 4-year programme called “Better Use of Environmental Management in the Public Sector” was initiated by the MOE. This project was followed by the next project that was targeted on improving environmentally sound public procurements. The program of trainings for government officials were organised to enhance the understanding and build knew knowledge on environmental issues. These programs originated from the EU initiative. Eco-Management and Auditing Scheme, developed by EC and implemented by several countries, and is used in the institutions of the public sector. An environmental management plan for 2012-20 was developed in order to improve measures for environmental management. (<http://www.envir.ee/en/>)

### Mechanisms for ensuring policy coherence, consideration of trade-offs between policy objectives, and the balance the interests of diverse stakeholders

1. OECD Public Governance Review (PGR) from 2011 points out that though the decision-making process in Estonia is very transparent, there are still some drawbacks in taking account stakeholders opinions. Survey by Praxis (2010) shows that biggest barriers to stakeholder participation with the state public administration are: too little preliminary information; too short timeframes for commenting; insufficient resources to divert to participating; and too time consuming participation. PGR concludes that Estonia has been successful in achieving stakeholder engagement goals in a relatively short period, but suggest that the engagement activities should be developed further, in order to make stakeholder engagement as effective as possible. Important suggestion for further improvement is made in embedment of stakeholder engagement into the culture of the public administration in the way that its benefits are identified at all levels of public administration and politics. (OECD 2011)

## Summary

* Estonia is a country with small domestic market with only 1.3 million inhabitants, known particularly by openness, liberal trade and investment laws, and balanced state budget.
* Estonia is performing above the OECD average in education and skills, environmental quality, and work-life balance, but below average in housing, jobs and earnings, subjective well-being, personal security, income and wealth, health status, and civic engagement.
* Due to continuing economic slowdown of the main trade partners, especially in Finland and Russia, the demand for Estonia’s goods and services has been low. Economic growth has been based on domestic consumption in recent years.
* The nature of competitive advantage is still in low-cost labour or natural resources.
* The wage growth has exceeded nominal GDP growth rate. Therefore, the profitability of companies has declined, being one reason behind low investments by companies
* Estonia is known as a country with very low general government gross debt with the goal to proceed with a sustainable fiscal policy. The budgetary objectives are concerned with a general government structural surplus, strict fiscal policy and low level of government debt. The priorities in State Budget Strategy bring forward reduction of tax burden of labour and sustainable public finance.
* The WEF GCI for 2015-16 rank Estonia 30th within 140 countries. Estonia is considered an innovation driven economy. Notably better has Estonia performed in macroeconomic environment and labour market efficiency. Even though, the overall performance is very good, Estonia lacks from market size and business sophistication.
* In business sophistication, companies are not successful in having broad presence in the entire value chain; rather they are involved in individual steps of the value chain. Estonian companies are not very successful in using marketing to differentiate their products.
* From innovation side, two things stand out. Very low availability of scientists and engineers for companies from one side and high level of government procurement of advanced technology products. In international comparison, Estonia still ranks as innovation-driven economy.

# 4. Investment in the food and agriculture system

## Regulatory environment for entrepreneurship

*The overall regulatory environment establishes basic conditions within which all firms, including farms, input suppliers, and food companies, operate and make investment decisions. Competitive conditions in domestic markets, including low barriers to entry and exit, can encourage innovation and productivity growth, including through their impact on structural change. Regulations may also enable or impede knowledge and technology transfer directly, contributing to more or less innovation, including in sustainability-enhancing technologies.*

### Prevalence of the state in business ownership and control in food and agriculture; business regulations and constraints on business start-up and exit

1. Estonian Entrepreneurship Growth Strategy for 2014-20 points out that the business environment in Estonia is generally business-friendly with still considerable room for improvement. The strategy sets two main objectives: 1) to increase productivity per employed person to 80% of the EU average; and 2) to raise the employment rate in the age group 20–64 to 76%. Entrepreneurship growth strategy targets mainly innovation and entrepreneurship and puts focus on growth areas and enterprises with strongest influence. Growth strategy is closely linked with other development plans. (Estonian Entrepreneurship Growth Strategy)
2. An essential part in successful enterprise growth is legal environment and regulations for business. In Estonia, legislators and governments have always set priority to policies that will improve the business environment in order to benefit from tax revenues and the jobs created by attracting foreign investors. Foreign investors and local entrepreneurs have equal rights and obligations. There are no restrictions to start business in Estonia on the same basis as local entrepreneurs. (Estonian Chamber of Commerce and Industry)
3. The role of the state is limited to establish legal environment for businesses and to provide public goods and services. The role of the state in business ownership in Estonia is negligible. In 2015, there were 25 solely state-owned companies (<https://www.eesti.ee/eng/contacts/riigi_osalusega_ariuhingud_2>). Only one of these companies is connected to agri-food sector, namely Vireen Ltd. (<http://www.vireen.ee/Home_500.htm>), which collects and recycles the perished farm animals and the animal by-products of the meat industry.
4. OECD Integrated Product Market Regulation Indicator (PMRI) (Figure 4.1.) measures the impact of regulatory framework on promoting competitiveness. According to PMRI, Estonia has very low level of restrictions and between measurement periods of 2008 and 2013, the level of restrictions has declined. In the scale from 0 to 6, with higher number indicating more restrictions, Estonia has overall score of 1.29 which is lower than OECD average (1.47) and EU average (1.44). The PMRI shows that Estonia’s position on regulations in the areas of state control and barriers to entrepreneurship is above OECD average, however, the indicator showing barriers to trade and investment is lagging somewhat behind.
5. Starting and running business in Estonia has very low barriers. Barriers to entrepreneurship indicator (Figure 4.2) expresses that Estonia is among least restrictive countries. Complexity of regulatory procedures and administrative burdens to start-ups have lower barriers than OECD average. Regulatory protection of incumbents is even better than in OECD top five countries.

**Figure 4.1. OECD Integrated Product Market Regulation Indicator (PMRI), 2008, 2013**

**Scale from 0 (least) to 6 (most) restrictive**

**A. Integrated PMRI, international comparison, 2008 and 2013**

**B. Estonia's integrated PMRI by component, 2013**

Indices for EU28 and OECD are the simple average of member-country indices.

Note: OECD top 5 refers to the average of the scores for the top five performers among OECD countries - Netherlands, United Kingdom, United States, Austria and Denmark.

Data for United States refers to 2008.

Source: OECD Product Market Regulation Database, 2014.

**Figure 4.2. Estonia's barriers to entrepreneurship indicator by regulatory area, 2013**

**Scale from 0 (least) to 6 (most) restrictive**

Note: OECD top 5 refers to the average of the scores for the top five performers among OECD countries - Slovak Republic, New Zealand, Netherlands, Italy and United States.

Data for the United States refers to 2008.

Index for OECD is the simple average of member-country indices.

Source: OECD Product Market Regulation Database, 2014.

1. From 2008-13, there has been a significant decline in barriers to entrepreneurship (Figure 4.3, Panel A). In comparison with the OECD average, the overall decline in barriers to entrepreneurship has been slightly bigger in Estonia. Estonia has witnessed considerable decline in barriers in network sectors, legal barriers to entry and in communication and simplification of rules/procedures. Althoug there has been no change in antitrust exemptions, administrative burdens for corporations and in licence and permit system. In comparison with the OECD best performing countries (Figure 4.3, Panel B), in 2013, Estonia lags behind the OECD top 5 performers, indicating scope for further improvement. There is room for further improvement, especially considering barriers in service sector, administrative burdens for corporations and access to licenses and permits.

**Figure 4.3. Product market regulation (PMR): barriers to entrepreneurship**

**A: Reforms have eased regulatory burdens B: There is scope for further improvement**

Change in PMR score1 Level of PMR score, 2013

Index scale from 0 (least restrictive) to 6 (most restrictive)

Source: I. Koske, I. Wanner, R. Bitetti and O. Barbiero (2014), ‘The 2013 Update of the OECD Product Market Regulation Indicators: Policy Insights for OECD and non-OECD Countries’, OECD Economics Department Working Papers, forthcoming.

1. Pro-market reforms and policies directed to openness have made Estonia’s business environment very entrepreneur friendly. WB’s Ease of Doing Business index ranks Estonia to 16th place among 189 economies in 2016 (Table 4.1.). This ranking characterizes both strengths and weaknesses. In starting business, dealing with construction permits, registering property and enforcing contracts, Estonia is among top performers in the World, but from the other hand in protecting minority investors and resolving insolvency Estonia is lagging behind.

**Table 4.1. Estonia’s ranking in World Bank’s Ease of Doing Business, 2016**

|  |  |
| --- | --- |
| **Overall rank out of 189 economies** | **16** |
| *Ranking by specific regulatory area* |  |
| Starting a Business | 15 |
| Dealing with Construction Permits | 16 |
| Getting Electricity | 34 |
| Registering Property | 4 |
| Getting Credit | 28 |
| Protecting Minority Investors | 81 |
| Paying Taxes | 30 |
| Trading Across Borders | 24 |
| Enforcing Contracts | 11 |
| Resolving Insolvency | 40 |

Source: World Bank, Doing Business 2015.

### Effectiveness of competition policy; application of general competition rules to agricultural and agri-food firms

1. Competition policy in Estonia is generally in compliance with the EU principles. Supervision in the fields of competition, electricity, natural gas, district heating, postal services, water and railways and dispute settling regarding airport fees is performed by the Estonian Competition Authority (<http://www.konkurentsiamet.ee/?lang=en>). Estonia is one of the few countries in the EU, where the anti-competitive agreements, so-called cartels, are processed in criminal proceedings (<http://www.koda.ee/en/services/business-environment/regulations-for-business/>).

## Regulations on natural resources

*Regulations on natural resources are central to ensuring the long term sustainable use of natural resources and in large part determine access to and use of land, water and biodiversity resources. They also impose limits on the impact of industrial and agricultural activities on the state of the natural resource (e.g. water pollution, soil degradation, greenhouse gas emissions). The design of natural resources and environmental policies is important in terms of their incentives for innovation and sustainable productivity growth.*

### The rules governing access to and use of natural resources, and environmental impact of agri-food activities (pricing, ownership, management, etc.); their design, enforcement and provisions governing agriculture uses

*Regulations on natural resources and environment*

1. Regulations on natural resources and environment in Estonia are distributed between several legal acts. One reason for this divisibility was the increase in number of legislative acts during and after the EU accession, when fast adoption of EU regulations took place. The General Part of the Environmental Code Act came into force in 2014 (some parts in 2015), thus developing a unified base for specific acts in environmental law.
2. In addition to the direct legal acts on environment and resource use, the Environmental Strategy 2030, the National Strategy on Sustainable Development “Sustainable Estonia 21”, the Estonian RDP for 2014-20, the National Reform Programme “Estonia 2020”, thematic and regional action-plans include requirements concerning environmental impact. The principles of the environmental legal acts are sustainable development, effective managing of natural resources, prevention and avoidance of environmental damages.
3. The main act regulating environmental supervisionis the Environmental Supervision Act. Furthermore, the execution of supervision is regulated by the Law Enforcement Act. The environmental supervision involves the control over the use of natural resources and products, the legality of the operations dealing with them, and the factors influencing environment. The main supervisory agency is the Environmental Inspectorate, in some cases also the local municipalities. During the environmental supervision, the supervisory authorities are permitted to perform control operations, and to prescribe injunctions, also to perform certain operations. (EELC 2016)
4. The environmental impact assessment (EIA) is carried out in case of planning an activity with significant environmental impact. The regulation of EIA has been stipulated by the EU directive 2001/42/EC (the so-called EIA directive). The actions with significant environmental impact have been listed in the Environmental Impact Assessment and Environmental Management System Act (EIAEM); whereas in case of some actions EIA is obligatory, in other cases the permission-granter has to weigh the necessity for EIA. The strategic environmental assessment (SEA) is carried out during the compilation of strategic planning documents (for instance the planning of land use, and development plans, including RDP). (EELC 2016)
5. Environmental monitoring includes continuous observation of the state of the environment, the factors affecting it, and analyses of observation information. This information contributes to the various activities of environmental planning. Environmental monitoring is governed bythe following instruments of international legislation: The Agreement between the European Community and the Republic of Estonia on the Participation of the Republic of Estonia in the European Environment Agency (EEA), the Ratification Act of the European Environmental Information and Observation Network (EIONET), The European Union INSPIRE Directive 2007/2/EC governing the establishment of the spatial data infrastructure of EC. Environmental monitoring in Estonia is governed by the Environmental Monitoring Act, the disclosure of the data obtained in the course of monitoring is made available by the Public Information Act. The preservation of environmental monitoring data is governed by the Environmental Register Act. Environmental monitoring data are generally public (including the compulsory monitoring data of an entrepreneur provided in the environmental permit), i.e, the collectors of the data are obliged to issue information under a request. Environmental monitoring data are assembled by the collectors in the Environmental Registry, available online. (EELC 2016)
6. The environmental liability is governed by the following international legal acts: the Council of Europe Convention on Civil Liability for environmental damage caused by hazardous activities, the European Parliament and Council Directive 2004/35/EC on environmental liability for preventing and remedying of environmental damages, and by following Estonian legal acts: Environmental Liability Act, the Additional List of habitat and species in the sense of the Environmental Liability Act and the risk of environmental damage and the list of data about the risk of environmental damage. Environmental liability in the strict sense applies to three types of damage – soil, water and biodiversity. First, the person who causes damage must promptly implement preventive measures. In the event of damage, the tortfeasor must work in cooperation with the Environmental Agency to work out the remedies, or to compensate for remedies or for the corresponding costs, as well as to implement preventive measures to limit the extent of the damage. If the person has acted in accordance with a permit issued, or made use of a technique in which the probability of occurrence of the injury was not foreseeable, he or she is exempted from the application of the measures. If the party causing the damage can not be ascertained, or he refuses preventive or remedial action, or is exempted from this obligation, the implementation of the right to reparation lies with the Environmental Agency. (EELC 2016)
7. Certain agricultural activities (incl. intensive livestock production) have an impact on various environmental elements (water, soil, air, waste, etc.). In order to assess and reduce the impact of such actions, an integrated pollution prevention and control mechanism has been worked out. According to this, enterprises over the threshold capacities (incl. farms with >2000 pigs; >40 000 poultry; >400 dairy cows; etc.) need integrated environmental permits (RT I, 11.06.2013, 19). Permits include assessment on technologies, work operations (e.g. milking, feeding, waste management), sustainable usage of raw materials, chemicals, water, fuels etc. compared to reference technology. The list and frequency of obligatory reports are specified in the permit. Extention of the permit and potential changes depend on the results of regular inspections (at least once a year). The conditions and restrictions in the permit must derive from the best available technology (BAT). BAT mean the most effective and advanced level in the development of activities and their methods of operation. BAT are suitable for determination of emission limit values and other permit requirements in order to prevent and to reduce emissions and the impact on the environment (RT I, 03.12.2015, 7). In Estonia, the area of integrated environmental permits is regulated by the Industrial Emissions Act, which in turn is compiled according to the directive 2010/75/EU issued by the European Parliament and Council. The actions requiring the integrated environmental permit have been stated in a governmental regulation. The integrated pollution prevention and control is regulated by the EU Parliament and Council directive 2008/1/EU, in Estonia also by Environmental Impact Assessment and Environmental Management System Act. (EELC 2016)
8. In order to direct people towards more efficient use of environmental resources and the reduction of pollution, environmental charges play a considerable role. The taxation of the use of environment and pollution increases the production costs, and could increase the product price dependending on the environmental impact caused by producing it. As the environmental charges are provisionally stipulated in the state tax policy area, EU has not issued legal acts in this field. In Estonia, the issue of environmental charges is regulated by the Environmental Charges Act. According to the Act, the environmental charges are divided into two: natural resource use fees and pollution fees that are designated to decrease the pollution from point sources. If the use of the environment exceeds the permitted amount or it takes place without permission, higher rates of pay will be implemented. (EELC 2016) Another mean for reducing the (diffuse) pollution from agricultural production is the obligation to follow environmental rules and good agricultural practice in order to be eligible for agricultural subsidies.

*Land use and soil*

1. Regulations on land use are given by several legal acts including Planning Act, Land Cadastre Act, Land Consolidation Act, Nature Conservation Act, etc. The access to agricultural and forestland is regulated through Restrictions on Acquisition of Immovables Act. There are restrictions for citizens and legal persons from third countries for acquiring property that includes agricultural or forestland. No restrictions are posed to citizens of EU and other countries, which are contracting parties to the EEA Agreement or member states of the OECD (RT I, 23.02.2012, 11).
2. Soil protection is ruled through the Earth’s Crust Act, Land Improvement Act and the Plant Protection Act. Management and protection of soils in Estonia is a complex issue, since the properties of soil and water regime conditions vary significantly within small areas. About 46% of Estonian soils have a very good potential fertility and good environmental protection value (EEIC 2013). Within the frames of agricultural policy and regulations, there are several obligations set to agricultural producers in order to conduct the sustainable usage of soil and substances used for improving soil fertility and plant growth. Field records with information of used plant nutrients have to be kept; determination of the acidity of soil, exchangeable P, K and organic carbon contents have to be monitored regularly by the recipients of agri-environmental subsidies. (EEIC 2013) The Department of Agricultural Research and Monitoring of the Agricultural Research Centre (ARC) conducts systematic comprehensive reviews of the environmental actions performed in the framework of the Estonian Rural Development Plan (ERDP). The indicators related to soil, water, biodiversity, landscape, social economy, etc. of the beneficiaries of the organic production support, environmentally friendly management support (EFM beneficiaries) and single area payment support (SAPS beneficiaries) are monitored. These indicators are also used for a multi purpose survey. The results of the 2011 soil fertility and organic matter survey show that the agricultural technology used by organic farmers cannot maintain the potassium (K) content in the soil, its average level in the soil goes down and the share of K deficient soils increases. One of the reasons for this is the fact that organic farmers use legume crops in crop rotations, which certainly has a positive impact on the humus content of soil, weed suppression and biological nitrogen use. At the same time, however, legumes remove a significant amount of K from the agro-ecosystems that the agricultural technologies used at present cannot compensate for. The possibilities the organic producers have to offset the K balance are relatively limited, but it is essential to find ways for the sustainable use of soils, either through the application of organic fertilizers or making changes in crop rotations. Changes in the soil fertility indicators of EFM and SAPS producers indicate that in the past five years more and more attention has been paid to achieving the nutrient balance through a variety of agro-technological methods (crop rotation, fertilization). (ARC, 2011)
3. Starting from 2015, the support for soil protection was evolved in order to compensate the sustainable usage of eroded and peaty soils on the fields that are not covered with other area payments under RDP support, with the exception of the subsidy for growing local varieties. (RT I, 26.04.2016, 6)

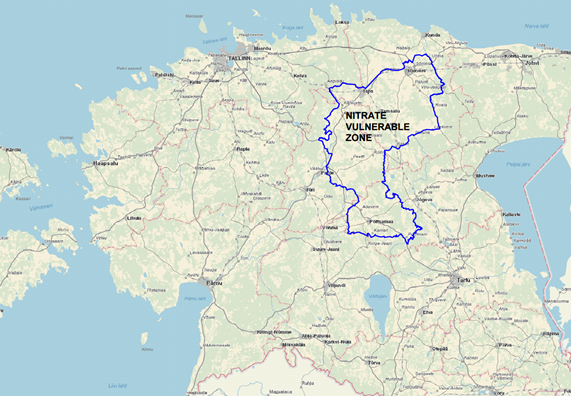
*Water*

1. The management and protection of water in Estonia is regulated with the Water Act, that is elaborated in accordance with EU Water Framework Directive (2000/60/EC); Marine Strategy Framework Directive (2008/56/EC); Urban Waste Water Treatment Directive (91/271/EEC); Nitrates Directive (91/676/EEC). In addition, the agreements within the Convention on the Protection of the Marine Environment of the Baltic Sea Area and the Baltic Sea Action Plan are the basis of water protection regulations in Estonia. The central objective of the regulations is to prevent deterioration of the status of water bodies and to avoid pollution from densely populated areas and agricultural lands. The evaluation of groundwater status in Estonia takes into account concentrations of nitrates, pesticides and other hazardous substances; assessment of surface water bodies bases on the ecological status and chemical indicators, including monitoring of the biota and the quality of surface water. (EER 2013). About 60% of the surface water bodies were in at least good overall status in 2014, nearly 60% of the surface water bodies being in at least good ecological status. Due to low population density and moderate agricultural intensity, the ecological status of Estonian surface water bodies has been among the best in Europe (Statistics Estonia 2016).
2. Water usage for production purposes is charged depending on the water layer used. Charges for abstraction of surface water range from 1.55-38.34 euros/1000 m3, depending the purpose of usage. Charges for water from aquifers range from 30.65 (Quaternary period aquifer) to 191.7 euros/1000 m3 (potable quality water from the Cambrian-Vendian period aquifers for technological purposes, except for production of foodstuffs). The specific provision for agriculture and fisheries is that charges arenot imposed for irrigation of agricultural land (incl. greenhouses) and for fish farming purposes. Since the irrigation is used mainly by private households in home gardens and by horticultural farms, the share of irrigation water in total water abstraction is irrelevant. (RT I, 17.12.2015, 44)

*Nitrates*

1. The regulations of Estonian Water Act on usage of organic fertilisers became more restrictive during 2014-16. The amounts of P and N per ha of land fertilised with organic fertilisers, including the manure left by grazing animals, are limited. The amount of N given with organic fertilisers is restricted to 170 kg per every fertilised ha per year. The amount of P given with organic fertilisers can be up to 25 kg/ha on the average of five consecutive years. The application of organic fertilisers on the soil surface is prohibited in the case of slope of the land more than 10%. On the fields that are not covered with plants, organic fertilisers have to be mixed into soil within 48 hours (within 24 hours starting from 2021). Fertilisation of natural grasslands is prohibited, except for the manure left by grazing animals. Requirements on the volume of manure storages are also given. Animal barns for more than 10 LU (more than 5 LU from 2023) are obliged to have a manure storage for solid and/or liquid manure depending on the manure type. Storage space must be sufficient for storing manure during eight months. Producers who have less than 10 LU, can store their solid manure temporarily on watertight ground near barn, protected from rainfall. The period of application of mineral and organic fertilisers is regulated based on weather and soil conditions. Fertilisation is currently not allowed during the period from 1 December to 20 March. During the period from 1-30 November, the application of organic fertilisers also on the fields with plant cover is allowed only in the case of incorporating into soil within 48 hours. Starting from 2021 the injection of liquid organic fertilisers is obligatory after 20 September on the fields with winter plant cover. A person engaged in agriculture must keep a field book, which entries must, inter alia, include the following information for each field: amounts of fertilizers used, including that of solid and liquid manure, their N and P content, time of use and names and amounts of the meliorants (soil amendments) used; the beginning and end date of the manure stockpiling, the date the manure from the stock is outloaded, and the location of the manure stack on the map of the Land Parcel Identification System. State supervision of the Water Act and the compliance with the requirements established by the regulations thereunder are exercised by the Environmental Inspectorate (exercises state supervision in the field of environmental protection), Health Board, VFB, the Environmental Board and the MOE. The polluted, poor or very bad status of water must be remedied by the polluter, or where the polluter cannot be identified, the owner of that particular waterbody, and in case of groundwater, the state. The violation of water protection and water use procedures by a legal person are subject to a fine of up to 2,000 euros. (out-of-court proceedings are taken by Environmental Inspectorate). (RT I, 06.01.2016, 14)
2. Aforementioned regulations give agricultural producers an incentive to improve the usage of plant nutrients of organic fertilisers. That means replacement of current application technologies of liquid organic fertilisers with more advanced equipment in terms of N losses during application. Poor market conditions on the other hand are hindering the change to newer technology at least in short-term perspective. According to the farm survey titled “The main production resource efficiency of agriculture in Estonia” (EMU 2013c), majority of dairy farmers who had liquid manure system, used trailing hose application or broadcasting systems with mixing into soil. Even in larger dairy farm groups (>100 cows), the share of trailing hose and broadcasting systems used is still large in addition to injection technologies. Contractors are employed for slurry injection, in order to shorten the application period and fulfil environmental requirements.
3. In 2003, the government decree of forming regionalNitrate Vulnerable Zone(NVZ)in Pandivere and Adavere-Põltsamaa region (Figure 4.3) was given. The area (3250 km2, i.e. 7.2% of territory of Estonia) was determined based on ground and surface water vulnerability (due to geological characteristics) and intensity of agricultural production in the region. The area of Pandivere region is 2,382 km2, where 19% of groundwater is unprotected. There are 135 springs and 741 karst holes in the region. The area of Adavere-Põltsamaa region is 667 km2; 18% of groundwater in the region is unprotected. (NVZ statistika) The cultivation value of soils in the NVZ is higher than the average cultivation value of arable land in Estonia (that is 43 points at 100-point scale). In the NVZ, the soil cultivation values are more than 55 points on some arable land and in between 50-55 ponts on other. As a result of good quality soils, the average share of agricultural land is 40% in the region based on the ARIB field register, that is 2 times higher than Estonian average [ENR 2016] Proportion of intensive agriculture in the area is between 13-15.4% (NVZ statistika), compared to the average proportion of 7.6% in Estonia in 2014 [KK81]. For example, wheat yields in the nitrate sensitive area (made up of three counties: Jõgeva County, Järva County and Lääne-Viru County) are either similar to or higher than the Estonian average (PM042). In 2007-14, the amounts of organic fertilizers used per fertilised ha of cereals and legumes fluctuated around the Estonian average, being higher in some years and lower in others. As to the use of mineral fertilisers, the amounts of N, P and K per fertilised ha of cereals and legumes in Jõgeva County exceeded the Estonian average in a few years, but fell behind the national average in Järva County and Lääne-Viru County. (PM067) Until 2012, the productivity of dairy cows was higher than the national average in all three counties (statistics available from 2004), whereas since 2013, the productivity of dairy cows has been exceeding the national average only in Järva County. (PM121)

**Figure 4.3. The area of Nitrate Vulnerable Zone in Estonia (until 2015).**



1. The restrictions and duties of NVZ are corrected in every fourth year based on monitoring data. MOE is constantly monitoring the changes in the surface water and groundwater status on the basis of the national water monitoring results. The groundwater nitrate levels in the Pandivere and Adavere regions have grown steadily, and due to high nitrate levels, the water in some wells has become undrinkable. Therefore, it can be said that the existing requirements are not sufficient. Decision process of changing restrictions and widening the surface of the zone is currently running in 2016.(MOE 2016…põllumajandus ja veekaitse)Agricultural production in this region is restricted in the aspect of fertilisation and land use (RT I, 06.01.2016, 14):

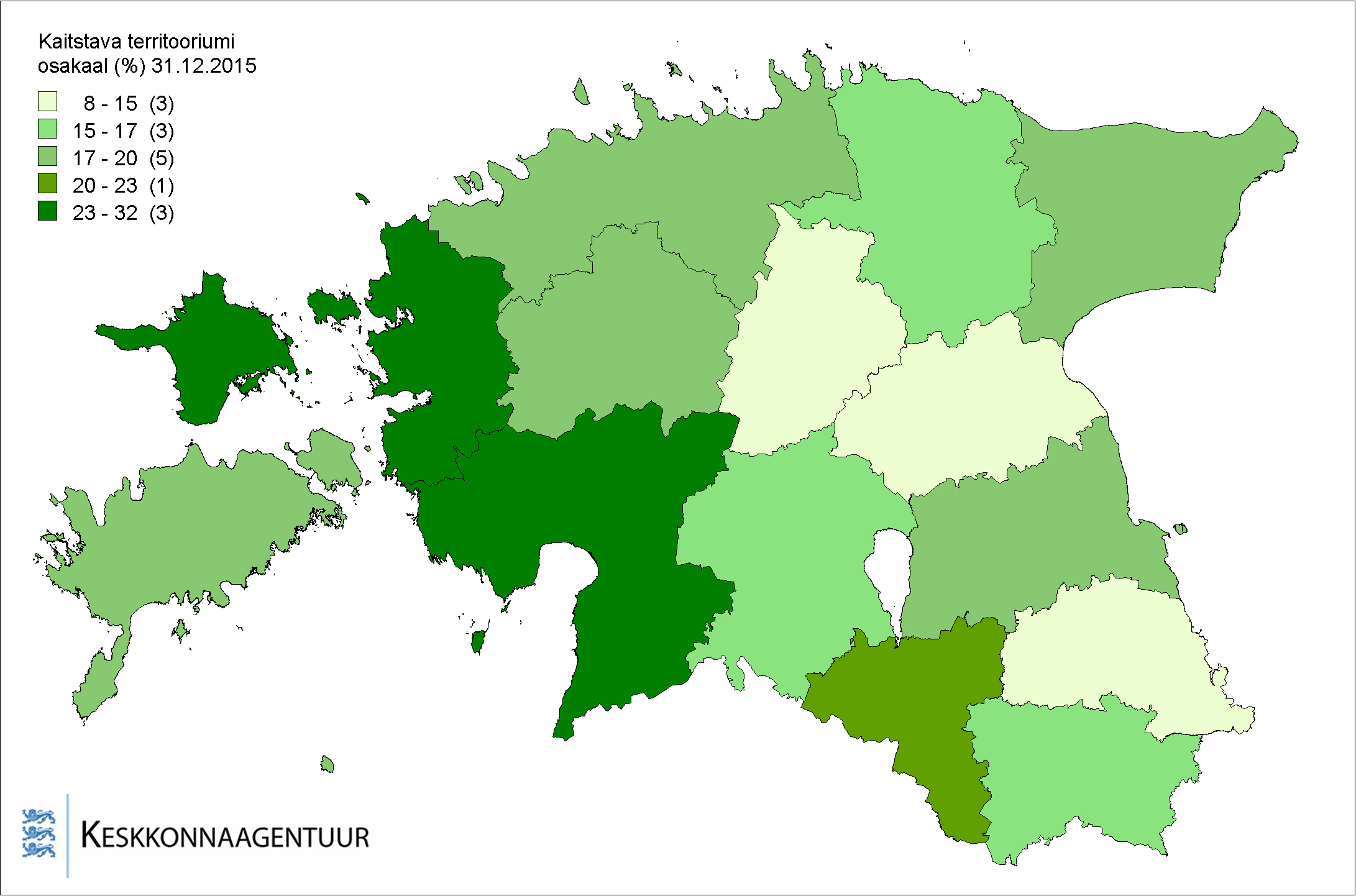
* At least 30% of arable land should have winter crop cover during the period of 1 November to 31 March.
* In areas with unprotected groundwater and a soil depth of up to 2 m, and in karst funnel areas, spreading of N with mineral fertilisers can be limited to 100 kg/ha per year; stocking density can be limited to 1.5 LU/ha and usage of waste water sediment can be restricted with the Order of Protection (RT I, 29.04.2014, 6).
* In areas surrounding springs and karstfunnels, in a range of 50 m from the boundary of the water or from the edge of a funnel, it is prohibited to use fertilisers, plant protection agents and to keep manure in a manure stack, if the Order of Protection will not state otherwise.

1. Eutrophication of the Baltic Sea is an important concern due to the specific features of its environment. Also several inland bodies of water in Estonia are in risk of eutrophication or are eutrophic, due to their natural conditions and influence from human activities. The status of water in Estonia was one of the best in the EU in 2010. Until 2014, the status of 155 bodies of water has declined, in the case of 56 of them the reason was excessive nutrient level (MoE, Põllumajandus ja veekaitse). Therefore, the stringency of regulations for preventing the increase of nutrient load has increased in recent years.
2. The results of water monitoring data from the period 2012-15 compared to 2008-11 period show that the overall nitrate content in rivers has been stable. Considering all the rivers monitored, the average nitrate content has decreased by 0.6 mg/l; nitrate content in winter decreased by 1.4 mg/l. Results from NVZ rivers show also decrease by 0.6 mg/l of the average nitrate content. Nitrate contents of coastal waters have also not changed – as average content, winter content and also the highest values of nitrate contents all have been below 1 mg NO3/l. (ENR 2016). The status of different rivers and water bodies have changed variously. The higher increase of nitrate contents in rivers of Northern Estonia is the result of the concentration of population and economic activity into the region.
3. Increase of the nitrate levels in certain agricultural locations in ground water and water bodies derives from the shift of animal production from smaller farms to larger animal production units and the increase of liquid manure technologies used. Thus, the drinking water quality in dispersed agricultural regions remains an issue. The specific geological features of NVZ soils, where fast filtration of nitrates to the ground water occurs, as well as higher rainfall levels and longer winter periods with no snow cover, has led to increased nitrate contents in ground water and in rivers starting from the springs of NVZ. Even if the relative increase of maximum nitrate contents in these rivers has been higher compared to reference period, the highest values measured have been between 13.3-28.8 mg/l, that is significantly lower than 50 mg/l. (ENR 2016)
4. Since agriculture gives big share of the nutrient load in Estonia (approximately 50% of N and 1/3 of P load), toughened regulations of manure handling and application technologies as well as restricted application rates are directed to decrease the nutrient load from organic fertilisers. Usage of mineral fertilisers is considered to be less important factor, since the relatively higher fertiliser prices compared to agricultural producer prices limit the usage of mineral fertilisers. The value of potential yield increase on Estonian soils does not cover the additional costs of (excessive) mineral fertilisation. In Water Act, the requirement for meeting the plants’ need of nutrients with mineral fertilisers is stated. (RT I, 06.01.2016, 14). The efficiency of mineral N usage has improved during 2004-12 (ENR 2016). Experts foresee that the increasing proportion of complex mineral fertilisers used in larger farms should enhance the utilisation of N by plants and thus decrease nitrate leaching (ENR 2016).
5. As a result of subsidy-supported investments into manure storages and other farm technologies, as well as the establishment of integrated environmental permit system, the risk of point source pollution from farms has decreased. On the other hand, the results of inventories have revealed shortcomings of silage storages, as well as waste water handling, especially in farms with older technological systems (ENR 2016).
6. The development of EFM subsidy schemes, organic subsidy scheme, etc. have increased the overall environmental awareness of farmers and spread of good management practices. The ARC survey in 2014 revealed that 77% of farmers applying for the RDP 2nd pillar subsidies followed all of the Codes of Good Agricultural Practise, compared to 57% of farmers who were getting only SAPS payments. Correspondingly 11% and 19% of the farmers followed the Codes partly (ENR 2016).

*Biodiversity*

1. The objectives on biodiversity and nature protection are included in several normative documents and programs. Nature protection is based on two directives: the EU Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) and the Birds Directive (Council Directive 79/409/EEC on the conservation of wild birds). The principles of these directives are integrated into the Estonian Nature Conservation Act. The overall development issues of nature conservation in Estonia are specified on The Nature Conservation Development Plan 2020 that is in accordance with the global and EU biodiversity strategies as well as the national level strategies on environment and sustainable development.
2. Estonia had 802,959 ha of land (18.5% of terrestrial area) and 761,591 ha of water area (28% of the territorial sea and large lakes) under protection on 31.12.2015. The total share of protected area was 22% of territory. (EEIC 2015) The biggest share of the area under protection is in the counties of the West coast of Estonia (Figure 4.4), where the bulk of valuable habitats and areas of protected species in Estonia are located.

**Figure 4.4. The share of the territory under protection in Estonia (at 31.12.2015).**



Source: EEIC 2015

1. Natura 2000 network of protected areas in EU member states is designed to fulfil the objectives of the EU habitats and bird directives. In Estonia, the Natura 2000 network includes 542 natural areas and 66 bird areas that are under protection based on Nature Conservation Act (data of 01.01.2012). The objects under protection include 60 types of habitats, 51 plant and animal species and 136 bird species. Total territory of Natura 2000 in Estonia was 1,475,200 ha in 2012, of what ca 50% was sea area. (MOE 2012 .. looduskaitse arengukava) For agricultural land in the Natura 2000 areas, the specific subsidy of agri-environmental scheme has been developed in order to compensate the additional costs incurred or income not received due to restrictions of management. The amount of subsidy is 27 euros/ha (RT I, 26.04.2016, 13). Furthermore, several other agri-environmental subsidies are available for supporting environment-friendly activities and improving the environmental awareness of agricultural producers: a) support for the maintenance of semi-natural habitats; b) support for environmentally friendly management; c) support for organic production. The measures of RDP are presented in the Chapter 6.
2. Another provision for agricultural producers in the areas under protection is the exempt of land tax. Land tax is not imposed on land where economic activities are prohibited by law, including the land of strict nature reserves, special management zones of protected areas and land of special management zones of species protection. (RT I, 17.12.2015, 52)

### Basis of environmental standards: environmental impact assessments, cost-benefit analyses, provisions for agriculture uses

1. Changes in environmental standards and regulations in Estonia are based on impact assessments on the following subjects: 1) environment; 2) society and demography; 3) economy; 4) security and international relations; 5) regional development; 6) administrative burden on institutions. This information is brought out in the explanatory notes of regulatory documents.
2. Elaboration of the methodology for external cost evaluation in sectors that influence environment considerably (*i.e.* oil shale industry) is planned for 2017. The Environmental Charges Act gives government an opportunity to increase the charges based on the occurred actual costs and also decrease the charges for instance in the case of economic difficulties of sector.
3. Impact assessment of RDP measures (incl. agri-environmental measures) is implemented in accordance with the EU guidelines. The process of policy-assessment includes *ex-ante*, ongoing and *ex-post* assessment based on monitoring data. Prior to acceptance, the environmental impact of the program as a whole was evaluated.
4. Agricultural producers have to fulfil “Good Agricultural Practices” and environmental regulations as a pre-requisite of receiving direct payments, thus the incentives to follow the regulations are high. Still the ongoing educating of producers is necessary in order to eliminate the mistakes because of lack of knowledge.
5. Indicators collected in order to monitor the status of environment and resource use in Estonia are numerous and scattered. A unified and representative data network on natural resources and environment is expected to be ready in 2020. The quality of environmental impact assessment and the proficiency of experts needs to be harmonised. (MOE 2012 .. looduskaitse arengukava)

### Policy targets regarding environmental pressures and states at regional, national and international levels; the state, trend on the distance-to-targets, and projections

1. The policy targets of Estonia include ensuring a clean living environment, raising the environmental awareness of the society, preservation of the natural values, and the sustainable use of natural resources. The framework for environmental protection and the sustainable use of the environment has been established in the Estonian Environmental Strategy 2030, which sets the long-term objectives in the areas of decreasing the waste, residual pollution and pollution load, water, mineral resources, energy, transportation, forestry, fisheries, hunting and maintaining landscape and biodiversity. One of the aims of the national development strategy Sustainable Estonia 21 (SE21) is the achievement and maintenance of the ecological balance (SE21). In addition, the 7th EU Environment Action Programme (EAP) “Living well within the limits of our planet” is valid till 2020. In order to achieve the aims, continuous control is exercised over the development of management processes and knowledge-based management and the improvement of strategic planning at the national level. MOE carries out impact assessments, develops the quality of public services, and introduces environmental management systems. (MOE. Strategy and Development; MOE. Management of the environment)
2. At the international level, the major regulatory agreements concerning the climate change are the United Nations (UN) Climate Change Framework Convention and the Kyoto Protocol. As a member of the EU, Estonia contributes to achieving the objectives of the 2020 climate & energy package, and 2030 climate & energy framework. Estonia has also supported objectives set at the Paris climate conference (COP21) to conclude a global climate agreement in order to avoid irreversible temperature rise and climate change. (MOE. Climate)
3. In nature protection, the main aims of the environmental policy are in line with different international agreements, such as the Ramsar Convention, the Bern Convention, CITES or the Washington Convention, the Rio de Janeiro Convention on Biological Diversity, agreements related to the Bonn Convention - EUROBATS and AEWA, HELCOM, IUCN, IWC (MOE. Nature conservation.). In addition, many of the policy objectives come from the following international multilateral agreements (MOE. International co-operation)

* Conventions regarding the protection of seas and sea pollution;
* Conventions regarding the protection of internal waters;
* Fisheries’ conventions;
* Conventions regarding hazardous waste;
* Conventions on nature conservation;
* Conventions regarding the prevention and avoidance of atmosphere pollution;
* Conventions regulating nuclear issues;
* Stockholm Convention on Persistent Organic Pollutants;
* The horizontal conventions on the environment: Aarhus Convention and Espoo Convention.

**Table 4.2. The indicators of the Estonian Nature Conservation Development Plan 2020**

|  |  |  |
| --- | --- | --- |
| **Indicators** | **Base level in 2011** | **Target level by 2020** |
| **Goal 1. People are familiar with, appreciate and conserve nature and know how use their knowledge in their everyday lives.** | | |
| Percentage of people in Estonia who regard their daily behaviour as environmentally aware | 22% | 35% |
| Number of nature education programmes taught in schools and nursery schools | 270 | 340 |
| Number of people who have completed an environmental education programme | 133 000 | Level achieved by 2014: 145 000  Level achieved by 2020: 175 000 |
| Number of disciplines incorporated into a conservation research programme | 0 | 6 |
| Number of visitors to nature trails | 1,55 million | 1,75 million |
| **Goal 2. The favourable conservation status of species and habitats and diversity of landscapes is ensured, habitats function as a coherent ecological network**. | | |
| Number of species of the Habitats Directive with improved conservation status | Favourable status – 23;  inadequate status – 41; bad status – 7; unknown status – 25 species | The conservation status of 28 species has improved, the status of all species is known |
| Percentage of species in a good conservation status among the species of the Birds Directive | 65% | 80% |
| Number of species with appropriate conservation guidelines | 45 | 155 |
| Number of new invasive alien species in Estonia per year | 2...3 | 0...1 |
| Area of maintained semi-natural communities | 25 000 ha | 45 000 ha |
| Percentage of strictly protected typologically representative forests in total forest land | 8.7% | 10% |
| Area of mire communities with a restored natural water regime | 100 ha | 10 000 ha |
| Number of habitat types  endangered at the European level whose conservation status has improved | Favourable status – 25;  inadequate status – 21;  bad status – 9;  unknown status – 5 habitat types | Conservation status of 14 habitat types (incl. their ecological coherence) has improved, the status assessment of all habitat types is known |
| Number of monitored species and habitat types | Monitored species of the Habitats Directive – 74  Monitored species of the Birds Directive – 120  Monitored habitat types – 26  Monitored Category I species – 54 | Monitored species of the Habitats Directive – 96  Monitored species of the Birds Directive – 221  Monitored habitat types – 60  All Category I species are being monitored |
| Number of indicator species indicating the coherence of the ecological network | 0 | 15 |
| **Goal 3. Long-term sustainability of natural resources, and the preconditions for this, are ensured and the principles of the ecosystem approach are followed in the use of natural resources.** | | |
| Number of habitat type groups (mires, forests, meadows, etc.) whose ecosystem services have been assessed | 0 | 6 |
| Area of rehabilitated cut-over peatlands | 0 ha | 1 000 ha |
| Size of selected game populations | wolf 200, lynx 700 | wolf 200, lynx 700 |
| Share of fish stocks in a good status in the total stocks of economically important fish species | 41% | 60% |
| Number of functioning ecoducts and small game tunnels | Ecoducts 0  Small game tunnels 10 | Ecoducts 4  Small game tunnels 20 |

Source: MoE, 2012.

1. In accordance with the Convention on Biological Diversity and the Global Biodiversity Strategy and the respective EU Biodiversity Strategy, Sustainable Estonia 21, the Estonian Environmental Strategy 2030 and the Estonian RDP 2007-13, the Estonian Nature Conservation Development Plan until 2020 has been prepared. It is a strategic document for the development of the areas related to nature protection and the use of nature. The strategic objectives of the plan include raising environmental awareness and nature valorisation, granting the preservation of the status of the species, maintaining a favourable habitat for species and for biodiversity and ensuring the sustainable use of natural resources by following the ecosystem approach principles. Nature Conservation Development Plan identifies base level indicators in 2011 and the target level for 2020 (Table 4.2). The deadline for achieving the stated objectives is set for 2018, 2020, or as continuous, which means that the interim reports are not yet available. (MOE, 2012) The indicator most directly linked to agriculture is ‘the area of maintained semi-natural communities’.

## Regulations on products and processes

*Regulations on products and processes aim to protect human, animal and plant health and can also impact on natural resource use. Environmental and health related regulations can boost innovation by building consumer and societal trust in the safety and sustainability of new products or processes, but unnecessary or dis-proportionate regulations can stifle innovation and technological developments.*

### Establishment and enforcement of regulations and private standards affecting processes and products; environmental regulations for products and processes, and recent developments

1. The environmental friendliness of agricultural production practices depends largely on the financial situation of the farmer (for example, for the purchase of new machinery or for increasing the manure storage capacity), awareness and objectives (including environmental awareness, which can promote, for example, a smarter use of pesticides) and governmental regulations and restrictions concerning agriculture. The EU Common Agricultural Policy (CAP) aims for a productive, competitive and sustainable agriculture. The prerequisite for receiving direct payments is the compliance of the farmer with cross-compliance requirements that include the Statutory Management Requirements (SMR) (prevention of nitrate pollution in a nitrate-sensitive area; conservation of wild birds, natural habitats, fauna and flora; food and feed safety, the use of hormones in livestock farming, animal identification and registration; transmissible spongiform encephalopathy (TSE), use of plant protection products, minimum standards for the protection of calves, minimum standards for the protection of pigs, the protection of livestock), and GAEC (water protection, soil and carbon conservation, preservation of landscape features and minimum level of maintenance).
2. Organic farming in Estonia is regulated by the EU Organic Farming Regulation (EC) No. 834/2007 (that regulates organic production and the labelling of organic products) and implementing legislation. The regulation clearly defines the aims, principles and general rules of organic production. The common basic principles laid down in the EU Organic Farming Regulation are directly applicable to Estonia. Moreover, at the national level, organic farming is regulated by the Estonian Organic Farming Act that establishes the requirements for operating in the areas not subject to the EU regulation, the scope and rules for national surveillance in organic farming and the provisions concerning the liability of farmers for non-compliance and the ordinances associated with it:

* Basic regulation for keeping the Organic Farming Register;
* Procedure for seeking approval for operating in in the organic sector;
* Requirements for organic production;
* Codes of the authorities exercising supervision over the persons employed in the organic sector;
* Standard description of the label referring to organic production methods and the procedure for using the label.

1. The terms “öko” and “mahe”, which are both legally acceptable terms in Estonian for “organic” and their derivatives may be used in labelling or promoting organic products, if at least 95% by weight of the ingredients of agricultural origin are organic. The products must have been grown on converted land or come from animals that have gone through the conversion period. The qualifying product must bear the EU organic logo, origin marking and the code of the supervisory authority. Depending on the origin of the raw material, the labelling must include indication of the place where the agricultural raw materials of the product were farmed: ‘Estonian Agriculture’, ‘EU Agriculture’, ‘non-EU Agriculture’, ‘EU/non-EU Agriculture’. In addition, the Estonian organic eco-label can be used, which indicates that the product is manufactured and inspected in Estonia and meets the requirements set out in the Organic Farming Act. Eco-labelled products must be produced in compliance with the requirements and they may be marketed only under state supervision. All companies engaged in organic farming are checked regularly at least once a year. All organic companies are listed in the Organic Farming Register, which is available on the website of the AB. The company must pay the state fee for registration, certification (approval) and surveillance activities. The supervision of organic farm production is the responsibility of the AB, while food and feed processing, marketing (incl. importing) and catering is the responsibility of the VFB. (MRA. Organic farming.)
2. Food safety issues, policies and actions cover the entire food chain, from the environment, production, processing and delivery to food processing, preparation and consumption. (WHO, 2015) The EU food policy includes, inter alia, profound food and feed safety and food hygiene regulations (EU, 2016). Primary and feed producers need to pay particular attention to food and feed safety requirements (unless produced for their own use). The beneficiaries of the EU CAP measures are affected by the cross-compliance system, where the list of statutory management requirements includes food and feed safety issues, which in turn consists of 13 requirements (set out in Food Act, Feed Act, and different MRA regulations). (MES) Compliance with the following acts is obligatory both for the farmers claiming support and not claiming support: Fertilisers Act (RT I, 01.09.2015, 35) that provides the requirements for fertilisers and their handling to ensure that fertilisers do not pose a threat to human and animal life and health or to property or the environment and that fertilisers have a favourable effect on plants and plant products; Water Act (RT I, 01.06.2016, 14), which regulates water use and protection, the relations between the landowners and the users of water, as well as the use of public water bodies and water bodies designated for public use; and Plant Protection Act (RT I, 01.09.2015, 2), which lays down the requirements for plant health and plant protection products that guarantee the safety of plant protection products to human and animal health and to the environment, as well as the requirements for plant protection equipment, and the grounds and scope of state supervision.
3. In addition to the safety in primary production of agricultural products, the overall safety of agricultural production for consumers is also of utmost importance. Pursuant to the EU food safety policy, Estonia also pays a lot of importance to food safety. The general principles and requirements are laid down in the food law and in the Regulation (EC) No 178/2002 of the European Parliament. Food safety standards and legislation are worked out by the MRA. MRA also exercises in-country control and monitoring of the food chain. In order to ensure food safety, MRA develops legislation related to food hygiene, food additives and contaminants and labelling, food contact materials and articles, novel foods and genetically modified organisms[[7]](#footnote-8) and other food groups or participates in the development of this legislation in the EU decision-making process. Additionally, MRA is responsible for the communication related to the international food standards programme *Codex Alimentarius* in Estonia and coordinates cooperation with the European Food Safety Authority (EFSA), the European Commission and the food supervisory authorities of the EU Member States. (MRA. Food safety.)
4. On the state level the legislation regulates the provision of veterinary services and the work of authorised veterinarians; animal health; animal protection; food inspection; organic farming; veterinary medicinal products; CAP in Estonia; alcohol surveillance; farm animal breeding; feed control; supervisory fees and state fees, as well as administrative and misdemeanour proceedings. Directly applicable EU legislation include those on animal health; animal protection; breeding of farm animals; food control; market organisation; international trade and organic farming. (VFB)
5. To ensure biosafety, general measures of food storage requirements are set down. Special requirements apply to handling and labelling of frozen food. Microbiological requirements have been established to assess food quality and the extent of food contamination. The reduction of anti-microbial resistance in ensuring food safety is gaining more and more importance. The content of food additives, flavourings, contaminants and food enzymes in food, as well as the application of materials and articles in contact with food, their application in accordance to the permissible standards and the relevance of processing methods are monitored closely in order to ensure chemical safety. Alcohol management, placing foods for particular nutritional use on the market, the safety of genetically modified foods, cross-compliance of enriched food, the use of food additives and placing novel foods on the market are regulated by both national and EU legislations. (VFB)

### Assessment of regulatory impacts when developing new and reviewing existing regulations

1. In order to shape political decisions in agricultural and food industry, MRA subscribes applied research. The results of the R&D activities financed by MRA (including animal health, welfare and breeding and collecting and maintaining genetic resources) help to improve the knowledge base and raise the level of employability, provide necessary guidance for successful management and science-based applications. To guarantee a high level of Estonian agricultural research, MRA strengthens local cooperation, promotes innovation, implements the European Innovation Partnership (EIP) programme, participates in research councils and committees and cooperates with other countries. (MOA. Research, development and advice.)

### Regulations specific to farms, input suppliers, or food companies that encourage or discourage development or adoption of new technologies and production practices

1. In order to qualify for the direct payments, the EFM and organic support, agricultural producers must meet the cross-compliance requirements. From 2015, the farmers claiming support under the single area payment scheme (SAPS) have to meet the requirements of the ‘greening’ – agricultural practices beneficial for the climate and the environment. It is one of the objectives of the CAP and is mandatory for all EU Member States. The goal of greening is to reduce the impact of agriculture on the environment by using environmentally friendly activities that contribute to soil and water quality, permanent grassland preservation, and improvement of biodiversity. These farming practices are annual measures that go beyond cross-compliance. For agricultural producers, greening denotes the introduction of production practices, which are based on crop diversification, maintenance of permanent grassland and the establishment of ecological focus areas. (TPL, OTK & MM, 2016)
2. All food-related companies have to comply with the general food safety principles to ensure food safety. The responsibility for ensuring food safety lies with food business operators, who must determine the stages in food handling which are significant from the food safety perspective, monitor them and register the results in accordance with the Food Act and the European Parliament and Council Regulation No 852/2004. Food business operators must be familiar with the requirements and HACCP principles. To ensure the compliance with the hygiene requirements and to make self-checks, the self-regulation operators may use guidelines, which are prepared at the EU level, by a local professional association or some other interested party. (MoRA. Food Safety.)
3. In order to help farmers and food businesses to develop jointly new products, processes and technologies, the state informs the producers about the applicable requirements, laws and their amendments, introduces the specificities of EU membership and support measures and supports the collaboration between the primary producers and the processing industry in the agricultural sector and promotes innovation. (MOA. Research, development and advice.) For example, in September 2016, Estonian food industry introduced the “Good practice of the application of the concept of ‘whole grain products’”, which defines the whole grain standard and formulates which products may be described as ‘whole grain products’. In case of bakery products, at least 50% of the constituents must be whole grain, in case of whole grain pasta and extruded whole-grain products, 100% of the cereal ingredients used in the manufacture must be whole grain. Transition to the good practice will take place gradually, food industry is expected to comply with the good practice by the end of 2017. In general, changes in agricultural production and food processing related legislation will lead to new production conditions that call for adaption, which in turn stimulate the development and introduction of new technologies and production practices.

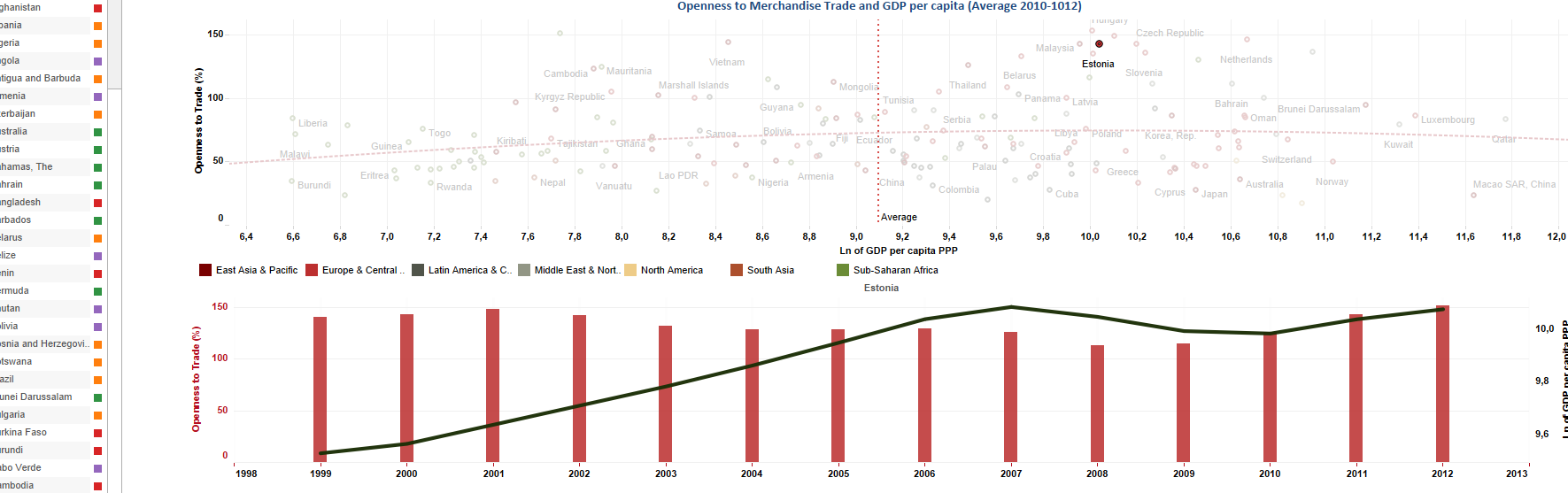
## Trade and investment policy

*Trade can facilitate the flow of goods, capital, technology, knowledge and people needed to innovate. Openness to trade and capital flows is conducive to innovation as it provides a larger market for innovators, reinforces competition, increases access to new technologies, ideas and processes, including from foreign direct investment (FDI) and related technological spill-overs, and facilitates cross-country collaboration. Trade and investment openness can influence innovation throughout the food supply chain, from input suppliers to food service and retail firms. Input and output markets that operate effectively can foster productivity growth. Trade and investment openness can also facilitate the development of market mechanisms to foster more environmentally sustainable production.*

### Exposure to trade (imports and exports) in the economy and the food and agriculture sector; level and measures of import (export) protection (restriction or subsidy), including for capital and intermediate goods; provisions for technological goods, knowledge supporting services, and for environmentally-friendly technologies

1. Estonia became a member of WTO in 1999. From 1 May 2004 Estonia is a member state of the EU and is member of WTO as a EU member state. Since becoming a member of the EU, Estonia is also included in Trade Policy Reviews of the EU. Before EU accession, Estonian policy towards foreign trade and investments can be described as unilaterally open. Due to the nature of macroeconomic reforms carried on in the beginning of 1990-s, Estonia became one of countries with the most liberal trade policy. All tariffs and quantitative restrictions were abolished. After EU accession, Estonia is a part of the common market with common trade policy.
2. Impact of EU accession on Estonian trade and especially on trade with food products was thoroughly analysed *ex-ante*. Varblane et al. (2002) pointed out that EU accession will change Estonian trade policy regime radically and that trade with food products will be the most affected. After accession, Estonia implemented common tariffs and all non-tariff barriers against third countries. Simultaneously with rising protection, there was also trade creation, as EU food market opened to Estonian exporters. Varblane et al. (2002) analysed in partial equilibrium framework that trade diversion had already taken place due to the fact that Estonia already implemented limited tariffs on food products against third countries since 2000. They estimated that 75% of import from third countries has been partly driven out by the import from EU and the countries with free trade agreements. Even though, Estonia had free trade agreement with EU already prior to accession this agreement did not concern agricultural and food products. Estonia did not apply any tariffs on imports originating from EU. Estonian exports of agricultural and processed food products to EU were restricted by tariffs and quotas. EU accession granted also free access to the EU agricultural and food products market.
3. Other aspect of Estonia’s EU accession was concerned with bilateral and regional trade agreements. Estonia had bilateral trade agreements with 25 countries and regional free trade agreement with Baltic countries. During the time of EU accession, the most affected trade agreement was one with Ukraine. Today, Estonia applies EU common trade policy and all the bilateral and regional trade agreements concluded by the EU are implemented in Estonia.
4. As it is pointed out by the MEAC, the organisation of foreign trade policy is divided between different ministries. Industrial products trading policies are mostly managed by the MEAC. The co-ordination of common foreign trade policy in general is managed by the Ministry of Foreign Affairs. Customs and taxation issues are managed by the Ministry of Finance. And agricultural products trading policies and related sanitary and phytosanitary measures are managed by the MRA. (MEAC web page)
5. Estonia is small open economy with limited factor of production to produce large nomenclature of goods and services. Therefore, Estonia depends on foreign trade. Together with implemented trade policy, it had made Estonia as one of the most open economies in the world. Figure 4.3 illustrates correlation between GDP and openness to trade. Openness to trade is the value of total merchandise trade as percentage of GDP (PPP). According to world bank data merchandise trade as a percentage of GDP was 100% in 1995 and 156% in 2000. Following the year of EU-accession merchandise trade was 128% of GDP in 2005 and started to decline during the crisis years. The lowest value was 98% in 2009. In 2014, the openness to trade was again higher being 130%.

**Figure 4.3. Openness to Trade, correlation between GDP and openness to trade (trade as percentage of GDP).**



Source: WITS

1. During the OECD accession process, Estonia participated in Review of Market Openness with the OECD Trade Committee. In the country review, the evaluation was given to domestic regulations directly or indirectly distorting or facilitating international competition. In addition, policies were suggested to improve the domestic regulatory framework for international trade and investment liberalization. Market openness review pointed out that Estonia applies an active infrastructure for regulatory transparency. The principle of non-discrimination is highly supported under the regulatory framework and particularly in the area of investment policy. (OECD, 2011)

### Efficiency and effectiveness of customs and border procedures

1. Level of protection in Estonian foreign trade is described by EU common tariffs. Compared to capital goods and industrial goods, the simple average of most favoured nation tariff rates applied on agricultural goods are higher (Figure 4.4.). EU tariffs on capital goods and intermediate goods are on average higher than simple average of all OECD countries, but tariffs for agricultural goods are on average lower compared to the OECD average.

**Figure 4.4. Import tariffs for industrial and agricultural goods, 2014 or latest available year.**

**Simple average MFN (most favoured nation) applied tariff rates**

Tariff rates for agricultural products include both ad valorem duties and specific duties in ad valorem equivalent, while tariff rates for agricultural products only include ad valorem duties.

Source: UNCTAD Trade Analysis Information System (TRAINS) (for non-agricultural products) and World Tariff Profiles, 2014 (for agricultural products).

1. OECD index of regulatory restrictions to trade and investments (Figure 4.5) evaluates the restrictions in four broad categories: tariffs, differential treatment of foreign suppliers, barriers to foreign direct investment and barriers to trade facilitation.

**Figure 4.5. Index of regulatory restrictions to trade and investment.**

**Scale from 0 (least) to 6 (most) restrictive**

**A. Index of regulatory restrictions to trade, international comparison, 2008 and 2013**

**B. Estonia's index of regulatory restrictions to trade by principle components, 2013**

Indices for EU28 and OECD are the simple average of member-country indices.

Barriers to trade facilitation refer to the extent to which the country uses internationally harmonised standards and certification procedures, and Mutual Recognition Agreements (MRAs) with at least one other country.

Tariff index is based on an average of effectively applied tariff, scaled within a range between 0 and 6 points, whereby a tariff below 3% is attributed zero points and a tariff above 19.6%, 6 points.

Note: OECD top 5 refers to the average of the scores for the top five performers among OECD countries - Netherlands, Belgium, Australia, United Kingdom and Finland.

Source: OECD Product Market Regulation Database, 2014.

1. Overall score of PMR index of regulatory restrictions to trade and investment shows that Estonia is slightly more restrictive (score 0.71) than OECD average (0.52) in 2013. Estonia has very low restrictions concerning trade and FDI. In the case of trade, the common trade policy of EU applies. Restrictions to FDI are among the lowest in OECD indicating that Estonia is open for foreign investors and both foreign and local investors are treated equally. In terms of differential treatment of foreign suppliers, Estonia is more restrictive compared to OECD average level. According to Estonia’s index of regulatory restrictions to trade, the differential treatment of foreign suppliers refers to limited situations where there are shortcomings when business practices are perceived to restrict competition in Estonia, namely in the cases when foreign firms need to redress. According to index of regulatory restrictions to trade, foreign firms have difficulties to have redress through trade policy bodies and private rights of action. But when business practices are perceived to restrict competition, foreign firms can have redress through competition agencies and regulatory authorities. Most restrictive compared to OECD average is Estonia in setting barriers to trade facilitation. Barriers to trade facilitation refer to the extent to which the country uses internationally harmonised standards and certification procedures, and Mutual Recognition Agreements (MRAs) with at least one other country.
2. OECD trade facilitation performance indicators cover different types of procedures performed in borders. There are few procedures where Estonia is lagging back compared to OECD average. Mostly in external and internal border agency cooperation. There is some backwardness in advanced rulings and formalities also. In all other procedures Estonia performs well compared to OECD average and particularly good concerning appeal procedures.

**Figure 4.6. Estonia’s trade facilitation performance, 2015**

Note: OECD top 5 refer to Australia, Netherlands, Ireland, Austria and Canada.

Source: OECD Trade Facilitation Indicators, 2015

### Clarity, transparency and accessibility of laws and regulations dealing with investments and investors; avoidance of unnecessary burdens on businesses and on society; restrictions on, or incentives for, foreign investment in agriculture

1. The FDI Regulatory restrictiveness index (Figure 4.7) describes Estonia as one of the countries with least restrictions to FDI. The scale of the index varies form 0 (least restrictive) to 1 (most restrictive). FDI restrictiveness index for Estonia in 2014 was 0.018, which is lower than OECD average (0.069) and EU average (0.097). Narrower indexes concerning FDI in agriculture and food sectors are as well below OECD and EU average levels, indicating very low level of restrictions. Sectoral indices in comparison with some larger economies are presented in Figure 4.8.

**Figure 4.7. OECD FDI Regulatory Restrictiveness Index, 2014**

Scale from 0 (least) to 1 (most) restrictive

Source: OECD FDI Regulatory Restrictiveness Index, 2015

**Figure 4.8. OECD FDI Regulatory Restrictiveness Index by Sector, 2003 and 2014**

Scale from 0 (least) to 1 (most) restrictive

Source: OECD FDI Regulatory Restrictiveness Index, 2014

1. Liberal economic policy and openness have made Estonia attractive destination of FDI. In 1990-s, most part of FDI was made through privatisation process, but gradually the emphasis shifted on investments into other enterprises and establishing new companies. After the completion of privatization, the structure of inward FDI has changed and dominating is acquisition of Estonian enterprise by foreign investors and re-invested profits by subsidiaries of foreign companies. In Estonia, government generally does not control FDI. There are few restrictions concerning certain sectors. These restrictions apply to foreign ownership by applying ownership responsibilities. Restrictions on Acquisition of Immovables Act provides the restrictions on the acquisition of immovables used as profit yielding land arising from public interest and the restrictions on the acquisition of immovables arising from national security reasons. A citizen of Estonia or another country which is a contracting party to the EEA Agreement or a member state of the OECD has the right to acquire an immovable which contains agricultural or forest land without restrictions. [RT I, 23.02.2012, 11].

**Figure 4.9. Total FDI inward stocks as a % of GDP, 2005 and 2014 or latest available year**

Source: OECD International Direct Investment Statistics, Benchmark definition, 4th edition (BMD4), 2015.

## Finance policy

*Efficient financial markets are one key to enable balanced development of any economy and society. Access to financial services can be limited or unequal across regions and firms when financial markets fail or when risks are too high. Policies that improve the functioning of financial markets can facilitate productivity enhancing investments in agriculture and farm size growth. Policies may also facilitate access to funding for sustainability enhancing investments. Low cost loans and venture capital can also be an important source of funding for innovative firms with high growth sectors potential.*

### Supply of finance and state of competition in the formal financial sector, including in rural areas

1. According to WEF GCI (Figure 4.10), Estonia ranks higher than OECD average in financial market developments. The mean aggregated results for Estonia are a bit higher than the OECD average and significantly higher than the EU28 average.

**Figure 4.10. WEF GCI: Financial market development, 2015-16, scale 1 to 7 (best)**

Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Finland, New Zealand, Luxembourg, Switzerland and Norway).

Source: World Economic Forum, The Global Competitiveness Report 2015-2016

1. The analysis of the index components shows that the lowest rating was given to the availability of loans and venture capital, but ranking was still higher than the OECD average. The only component, which scored lower than the OECD average, was financing though local equity market. As everywhere else in Europe, the main sources of financing for the Estonian entrepreneurs have been banks. The entrepreneurs are not aware of the various possibilities for attracting equity capital, and so far, there are still virtually no opportunities for equity exposures. Estonian companies are relatively small and therefore comparatively little public information is available, which does not make the companies particularly attractive to external investors. Also, companies do not want to relinquish control over their businesses. The survey conducted among the Estonian farmers at the end of 2015 revealed that 71.5% of the entrepreneurs are not ready to transfer parts of their company or the company shares to other parties, justifying this with the reluctance to lose control over their company.
2. Compared to other countries, the indicator of legal right index is ranked relatively highly. Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. When analysing the changes in the various components of the index over the past five years, it can be observed that the values ​​of all the components have gone up. The scores for the availability of loans and access to venture capital have increased the most.
3. The loan balance (in current prices) granted by credit institutions to the companies operating in agriculture, forestry and fishing has doubled over the past ten years. In 2009-11 the loan balance grew slowly, but by the end of 2012, the indicator rose by 25% as compared to 2011 (Figure 4.14). The loan balance of companies operating in agriculture, forestry and fishing constituted 5.4% of the total loan balance as of the end of April 2016 (in 2005 the figure was 3.8%). In relative terms, the balance of loans granted to the agricultural sector has increased, but since 2014 it has remained fairly stable.

**Figure 4.14. Loan balance of companies operating in agriculture, forestry and fishingand their share in total loan balance, 2006-2016**

Source: Bank of Estonia

1. In Estonia, there are nine credit institutions and seven branches of foreign credit institutions, functioning with an operating licence, but two of these credit institutions – Swedbank and SEB Bank hold the biggest market share of the loan capital granted to the agriculture sector. Loans to agricultural sector granted by Swedbank make up about 27.5% of the market share of the agricultural sector. The same figure for SEB Bank is 34.0%. In recent years, a number of other credit providers have entered the credit market, but the interest rates offered by these credit providers are considerably higher (starting from 8%).
2. Based on the statistics published by the BE, interest rates on loans granted to enterprises operating in agriculture, forestry and fishing and the average interest rates on loans in all areas of activity are set out on Figure 4.15. As long-term loans are mostly linked to Euribor, in addition to the interest rates, the 6-month Euribor of the respective years is also pointed out.

**Figure 4.15. Interest rates on loans by fields of activity in 2006-16**

Source: Bank of Estonia

1. The interest rates on lo ng-term loans reached a peak in 2008, after which the rate began to decline and the average interest rate by fields of activity dropped to 3% from the end of 2013. A general decline in the interest rates was brought about by a slump in Euribor rates. From 2010-14, the interest rate on loans in the agricultural sector was comparable to or even lower than the average interest rate across all sectors, but since 2015, higher interest rates on loans to the agricultural sector could be observed. In connection with a decline in agricultural producer prices, the financial solvency of agricultural enterprises has remained low and, therefore, banks have become more conservative, and all credit seekers do not get a positive response. Decrease in solvency increases exposure to the credit risk, which, in turn, brings about a rise in interest margins. In other words, credit institutions have imposed a higher risk margin on enterprises operating in the agricultural sector.
2. A survey conducted by Krediidiinfo Ltd. pointed out that in 2015, the proportion of corporate payment defaults in the field of agriculture, forestry and fishing 2015 increased from 4.3% to 4.8%. At the beginning of 2016, the average amount of payment default was the highest in the agricultural sector as well. Bank representatives are closely monitoring the cash flows in the companies and, if necessary, a grace period is allowed. Compared with cereal and vegetable producers, milk producers are in a really poor state and, for example at the beginning of 2016, nearly a quarter of the loan portfolios in the dairy sector held by Swedbank had been granted a period of grace. In comparison, it should be stated that in 2013 grace periods were not practically applied for.

### Access of food and agricultural firms to credit and finance; the nature of the constraints

1. The European Commission monitors Developments in SMEs’ access to finance through the joint European Commission/European Central Bank Survey on the access to finance of Enterprises (SAFE). The results of the SAFE Analytical report 2015 show what sources of funding are considered the most important by Estonian small and medium-sized firms. The results are compared to the average EU28 results (Figure 4.16).

**Figure 4.16. Sources of external financing of SMEs, percentage of all respondents**

Figures refer to the following question: „Are the following sources of financing relevant to your enterprise, i.e. have you used them in the past or considered using them in the future?

Source: SAFE, 2015

1. Figure 4.17 gives an overview of the factors that are likely to become an obstacle to seeking financing. Slightly more than a third of the respondents do not face any obstacles in finding financing, while over 10% of the companies consider no access to financing their biggest problem. Insufficient guarantee is considered to be a limiting factor in obtaining financing both in Estonia as well as in other EU countries. But in Estonia interest rates are not considered so high that they would limit financing, i.e. high interest rates were seldom marked off as factors hampering financing.

**Figure 4.17. The factors limiting the access to future financing, percentage of all respondents**

Figures refer to the following question: “*What do you see as the most important limiting factor to get this financing?“*

Source: SAFE, 2015

### Government programmes to improve access to finance (grants, interest concessions, guarantees); those that are specific to agricultural and agri-food firms

1. It is possible for the rural enterprises in Estonia to use a variety of financial services with the mediation of the Rural Development Foundation (RDF). RDF is a foundation founded by the state which goal is to support and stimulate entrepreneurship in rural areas by providing the rural enterprises and farms opportunities for accessing financial capital (guarantees, direct loans, loans to credit institutions).
2. RDF issues guarantees for the debt obligations of entrepreneurs (loan, leasing, etc.) with an aim to ensure a better access to credit facilities by increasing the creditworthiness of the borrower (which can be reduced by insufficient or illiquid collateral (underlying assets), high risk start-ups, changing the area of ​​activity, absence of earlier borrowing experience or unclear reliability) (RDF). In 2015, RDF issued guarantees to a total of 362 enterprises, the majority (81%) of which were micro-enterprises. The rest were small and medium-sized companies. The volume of guarantees provided by the RDF has multiplied over the decade (Figure 4.18). The ratio of guarantee portfolio to guaranteed loans in the period under review was slightly above 50%.

**Figure 4.18. RDF guarantees and the residual value of guaranteed loans, 2006-15**

Source: Rural Development Foundation (mes.ee)

1. In 2015, agricultural enterprises held the largest share of guarantee contracts (42.2%). Industrial enterprises located in rural areas ranked the second (13.2%) (including food industry by 1.8%) and the rest of guarantee contracts belonged to other activities (construction, biofuel, wood processing, forestry, etc.), but their shares were lower than 6% of the total guarantee contracts.
2. RDF provides both direct loans to businesses and loans through a credit institution. Loans through a credit institutions are meant for commercial and non-profit sectors, both for long- and short-term investments. The loans are earmarked. In 2015, direct loans to agricultural enterprises constituted 35.7%, and loans through credit institutions accounted for a bit more than 10% of the total volume of loans. Loans to agricultural enterprises formed nearly half of the total loan volume. Nearly 20% of the loans went to the renewable energy sector and fisheries received 12.4% of the lending volume.
3. Due to the reform of the budget, in the new EU budgetary period from 2021 onwards, the support to entrepreneurs is likely to decline significantly or disappear altogether. Having acknowledged the situation, the state is seeking ways to reduce risks so that the situation of 2009-10 would not be repeated, when the banks lost the ability, interest and willingness to lend money to enterprises. Consequently, the government is working on reducing the dependence of rural entrepreneurs on investment grants. Draft legislative acts governing the next EU budget period provide for a variety of financial instruments, including loans, guarantees and equity investments.
4. Starting from 2016, the RDF under a contract with the MRA will issue loans (growth loans and long-term investment loan) and collaterals to the entrepreneurs in agriculture, food industry and in rural and collateral. The RDF funds are allocated from the measures of the Estonian RDP 2014-20 and their total volume is 36 million euros15. The measure is expected to improve the access of the food sector and the rural entrepreneurs to capital and allow the necessary investments for which financing is otherwise difficult to find at the market.
5. The RDF and the Government of the Republic of Estonia are considering launching a commercial organisation in cooperation with the farmers to provide alternative financial services to the agricultural and fishery producers, which would contribute to the diversification of the funding possibilities for businesses. One of the alternative financial services under consideration is property sale and leaseback that is directed at producers.

### Programmes that target credit for innovation or for investment in environmentally-friendly technology; those that are specific to agricultural and agri-food firms

1. The Estonian RDP 2014-20 will support farmers in making investments into tangible assets, which will help the entrepreneurs to modernize production and increase productivity, promote joint economic activity, build and upgrade environmental-friendly agricultural and livestock facilities and produce bioenergy for their company's use. Payments will be made from the European Agricultural Fund for Rural Development (EAFRD) and from the state budget. The specific objectives of measure are, first and foremost, building and upgrading environmentally friendly agriculture and livestock facilities and ensuring the security of environment tally friendly energy supply to agricultural businesses. As a rule, the support constitutes up to 40% of the eligible cost of the supported action, whereas the purchase of tractors is supported in the amount of up to 30%. The support rate rate is up to 5% higher if the support is applied by a young entrepreneur aged up to 40 years of age, or by a group of connecting farmers. The planned budget for the measure “Investments into improving the efficiency of agricultural businesses” for the period 2014-20 is 146 million euros.

## Tax policy

*Tax policy affects innovation, productivity and sustainability in many ways: it affects the decision of firms and households to save or invest in physical and human capital, and thus the adoption of innovation; it raises government revenues, which can then finance public services, including those enabling innovation such as education and skills, R&D, and strategic infrastructure; it can also be used to provide direct incentives, for example preferential tax treatment to investments in private R&D or to young innovative companies. In addition to its economy-wide impacts, tax policy influences the conduct, structure and behaviour of farm, input suppliers and food companies. Taxes on income, property and land and capital transfer, including land, may affect structural change, while differential tax rates on specific activities (polluting or environmental friendly), resources, or input use may affect sustainability.*

### Tax arrangements to business that might encourage or discourage investment (income, property, sales, import and export taxes)

1. In Estonia, the objective of the government’s tax policy is a partial shifting of the tax burden from income taxation to the taxation of consumption, use of natural resources and the pollution of the environment. However, at the same time the government tries to keep the tax system simple and transparent with as few exceptions as possible. In the view of the government, the tax system, which consists of national and local taxes, is sustainable and both socially and regionally balanced. In recent years no surveys studying the achievement of the fiscal policy objectives have been carried out.
2. In the Estonian social security system, social tax is financed from the social tax imposed on employers and sole proprietors. The contributors of the social tax are employers, sole proprietors (self-employed persons) and the state. The rate of social tax in 2016 is 33% of the gross salary and entrepreneurial income of sole proprietors. In 2017, the social tax rate will be decreased to 32.5% and from 2018 to 32%. There are specifications to collecting social taxes from sole proprietors’ income and emoluments fringe benefits payable to the employed. The employer pays the unemployment insurance benefit (the rate of 0.8%), which is classified as employers’ charges, on the emoluments payable to the employed.
3. Customs duty is collected on the basis of EU Regulations (Council Regulation 2913/92/ EEC and Commission Regulation 2454/93/EEC).
4. Alcohol, tobacco, fuel and electricity are taxed in Estonia pursuant to the relevant EU directives. As an exception, a reduced rate of excise duty on beer is applied to small producers, and in agriculture and commercial fishing, discount rates are used on specially marked diesel fuel. Packaging Excise Duty act is valid in Estonia.
5. As to property taxes (classified also as wealth taxes), land tax and a heavy goods vehicle tax have been imposed in Estonia. In addition to environmental taxes (excise duties on fuel and electricity, heavy goods vehicle tax and packaging excise), various environmental charges have been introduced that are also classified as environmental taxes in the statistics. According to Eurostat, environmental taxes and charges comprised 8.3% of the tax revenues and social security contributions, exceeding the EU28 average of 6.4% by 1.9 %-points in 2014. The corresponding figures for 2002 were 6.4% and 6.8%, which means that the indicator for Estonia was 0.4 %-points lower. Investments in the environment are mostly encouraged by the EU support programmes and the possibility to substitute the obligation to pay the pollution tax for making investments in environmental protection measures.

### Provisions for farms or agriculture related businesses, e.g. income smoothing, tax rebates on land transfer, taxes on farm inputs.

1. In Estonia, a distinction should be made between the taxation of companies (public limited company, private limited company, limited partnership, general partnership or cooperative) and sole proprietors. As of 1 January 2016, 7447 companies (4.4% of the total registered companies) and 10,715 sole proprietors (33.3% of the total registered SPs) were registered in the field of agriculture, hunting and fishing. Farms and agri-food firms are generally subject to the same taxation regime as the rest of the economy. There are differences in the taxation of the return on sales of self-produced unprocessed agricultural products, of land used in agricultural production, and reduced excise duty rates for agricultural producers and small producers of beer.

*Taxes on self-employed person's income*

1. Since 2015, the personal income tax rate for taxable income, including business income is 20%. **In 2016, the basic exemption for resident individuals in Estonia is 2,040 euros per year (170 euros/month) and it is scheduled to increase.** The proposed tax-free income in 2017 is 2,160 euros, in 2018 2,280 euros and in 2019 2,460 euros respectively.
2. From 2017 onwards, low-paid employees working full time have the possibility to increase their income by applying for remuneration pursuant to the tax return or support paid once per calendar year. The rate on the basis of which the amount of refund is calculated is established by the state budget for the year on the basis of which the refund is calculated, taking into account the estimated subsistence minimum and minimum monthly wage in the case of full-time employment. For example, the 2016 Budget Act established the refund rate for 2017 at 228 euros (2016 State Budget Act § 2, article 7, item 6). The specified rate cannot be set lower than the estimated subsistence minimum last published by the Statistics Estonia. (Labour Market Services and Benefits Act § 374). The upper limit of refund is the amount of the income tax liability for the previous calendar year calculated on the basis of the income tax return of the natural person after the deductions allowed by the Income Tax Act have been made from the taxable income. (Labour Market Services and Benefits Act § 373). A natural person who has fulfilled all the following conditions for each calendar month to be taken into account during at least six calendar months in the previous calendar year is entitled to apply for a refund:

1) has been a resident during the whole calendar month;

2) has been at least 18 years of age during the whole calendar month;

3) on the basis of the data in the employment register, has been employed during the whole calendar month on the basis of at least one employment contract or in a service relationship and such employment had not been suspended;

4) on the basis of the data in the employment register, has been employed during the whole calendar month on the basis of at least one employment contract or in a service relationship full time. (Labour Market Services and Benefits Act § 372).

1. In the period of taxation, a SP can additionally deduct up to 2,877 euros from the income received from the disposal of self-produced unprocessed agricultural products minus the documented business expenses. Cleaning, sorting, cutting, drying, cooling and packaging of agricultural products is not considered processing. In 2015, the supplementary deduction for SP amounted to 2.5 million euros (MOF as of 26.5.2016), constituting 0.3% of the value of agricultural output.
2. In Estonia, self-employed persons have the opportunity to postpone their social and income tax payment without limitation in time by using a special account, collecting, for example, money for major investments. A SP may open one special account in a credit institution, which increment during the taxation period is deducted from the business income of the same period and which shall decrease is added to business income of the same period. The interest on the special account is taxed as business income. The regulations concerning the special account are accurate, and accounting for the changes in the special accounts over different periods of taxation is complex. Special accounts are not widely used. Only 4.4% of the 33,357 submitting their annual tax return and reporting business income stated some movement in the special account.
3. Entertainment and representation expenses for the catering, accommodation, transport or cultural services rendered to business partners or guests may amount to 2% of the deductibles corrected gross revenue.
4. In case the business related expenses exceed the business income, the cost of business expenses surpassing the business income may be deducted from the business income of the following seven taxation periods.
5. In case the business assets are transferred from one SP to another or to another company, which will continue its activities, the SP may, together with the assets, also transfer the carryforward amount of the costs and balance of the special account on a tax-free basis.
6. When calculating the income tax, the SP social tax contributions are not handled as business income. As a rule, the social tax (rate 33%) paid by a SP per year is not smaller than the monthly rate established in the Social Tax Act (390 euros in 2016) and multiplied by twelve (in 2016: 12x390x33%=1,544.40 euros per year), but there are a number of exceptions. The maximum social tax liability of a SP is calculated on the basis of the 15-fold amount of minimum monthly wage rates in the tax period (430 euros in 2016). SPs and companies are subject to different treatment as regards social tax: SPs receive benefits (sickness and pension insurance) and the maximum limit for the social tax has been set (in 2016: 12x430x15x33%=25,542 euros), whereas a company pays the social tax, there is no maximum limit and the employees receive the benefits.

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| Box 4.1 Calculation of business income for a self-employed person (SP)  |  |  | | --- | --- | |  | Business revenue (including farming support, interest on special account) | | - | Business-related expenses (except for SP social tax, income tax, mandatory contributions to the pension scheme) | | = | Gross revenue form Estonia | | +/- | Gross profit from abroad | | = | Total gross revenue | | - | Additional deductions from net sales of self-produced agricultural products and timber sales | | = | Deductibles corrected gross revenue | | - | Entertainment and representation expenses (up to 2% of the deductibles corrected gross revenue) | | - | The increment of the amount on the special account | | + | Decrease in the amount on the special account, or the amount on the special account at business termination | | = | Gross revenue corrected by the amount on the special account | | - | Deductible proportion of any expenses exceeding the business revenue in the previous period(s) | | = | Income before social tax | | - | Social tax | | = | Taxable business income | |

*Taxes on corporate income*

1. From 2000, an exceptional corporate income tax system has been imposed on companies in Estonia regardless of their field of operation: companies are subject to corporate income tax only in respect of dividends, or on other payments made to capital holders from equity. All undistributed corporate profits are tax-exempt. During a calendar year, corporate income tax is levied on (1) fringe benefits and the social security tax imposed on them; (2) gifts and donations; (3) representation expenses, (4) dividends and other profit distributions, and (5) expenses and payments not related to business. The income tax rate is 20% (as of 2015), and the taxable sum (dividends or previously listed objects) is first divided by 0.8 and then multiplied by the tax rate. Maximum tax-free levels are set for gifts and donations and representation expenses. Income tax is not charged on gifts and donations made during a calendar year to tax-advantaged non-profit organizations in an amount not exceeding one of the following limit values: 3% of the amount of the payments subject to social tax and 10% of the profits for the last financial year. Income tax is not charged on representation expenses in the amount of up to 32 euros per calendar month plus 2% of the social tax payments. The limit values are summed up for the whole year. Figure 4.19 shows the combined corporate income tax rate, which includes both the national and local income tax rates, in the OECD tax database in 2016.

**Figure 4.19. Combined Corporate Income Tax Rate 2016 (%)**

Estonia: from 1 January 2000, the corporate income tax is levied on distributed profits.

Source: OECD Tax Database <http://stats.oecd.org//Index.aspx?QueryId=58204>

1. Among other things, the Global Competitiveness Report 2015-16 highlights the present tax rates in force and the complexity of tax regulation as the problematic factors affecting business. The study shows that the total tax rate as a percentage of profit in Estonia is 49.3% (110th place among 140 countries). As to the effect of taxation on the incentives to invest, Estonia was ranked 15th and the effect of taxation on incentives to work 47th among the 140 countries. In the WB’s study Doing Business 2014, which is a basis for the Global Competitiveness Report 2015-16, the corporate income tax, the dividend tax, employer’s social security contributions and labour taxes, property taxes, waste collection taxes, vehicle taxes, tolls and other taxes imposed on the model business in the second year of operation are taken into account towards calculating the total tax rate (%) of profit (Figure 4.20).

**Figure 4.20. Total Corporate Tax Rate of Profit 2013 (%)**

Source: World Bank Group and PwC (2015), Paying Taxes 2015 - The Global Picture, PwC, World Bank and IFC.

*Property taxes*

1. The share of property taxes is very low in Estonia, with very few distinction for farmers. Land tax is a state level tax, which accrues entirely to the budget of the local governments. The tax is paid by the land owner, in some cases, the land user (if entered in the Land Register or the lessee of public land). The amount of land tax is obtained by multiplying the assessed value of land by the land tax rate. Assessed value of land is determined by the regular evaluation procedure through mass land evaluation and on the basis of market information. Land tax is imposed on land only without the buildings, forests, plants and other accessories. The land tax rates are imposed by national Land tax Act, but the applicable tax rate is established by the local government council within the set out range. The land tax rate is generally 0.1-2.5% of the taxable value of land annually. As an exception, the rate of land tax for areas under cultivation used for the production of agricultural products is 0.1-2.0% of the assessed value of the land annually. The land tax burden of agricultural producers may vary across regions. The information from the Estonian Tax and Customs Board shows that the tax rate most widely used by local authorities for the production of agricultural products and for natural grasslands is 2% (in 103, or in 37.7% of local government units) (Land tax rates ...). The average land tax in 2014 amounted to 2.37 euros/ha, whereas the mean land tax for areas under cultivation for agricultural products and natural grasslands was 1.24% of the assessed value of the land determined in the regular evaluation (Pedaste 2015). Thus, it can be stated that the use of agricultural land is subject to lower tax.
2. Heavy goods vehicles tax is levied on the trucks with a maximum authorised weight or gross laden weight of not less than 12 tonnes that are registered in the traffic register or road trains composed of trucks and one or more trailers with a maximum authorised weight or gross laden weight of not less than 12 tonnes whereas the trucks are registered in the traffic register. The tax is paid by natural persons residing in Estonia on a temporary or permanent basis, who are the owners or users of the heavy goods vehicles and have been entered in the traffic register, as well as legal persons registered in Estonia. Heavy goods vehicles are taxed based on the maximum authorised weight, number of axles and the type of suspension of the driving axle of the truck.

*Reduced fuel excise duty for diesel fuel for specific purposes*

1. Pursuant to the Fiscal Marking of Liquid Fuel Act of 1 January 2015, fiscal marking applies to diesel fuel that is intended to be used:

* in machinery, tractors and non-road mobile machinery used for agricultural purposes and in drying facilities that are used to dry agricultural produce;
* in commercial fishing.

In 2015, the value of fiscal benefits used in agricultural machinery, tractors and mobile machinery, and agricultural drying kilns amounted to 35 million euros (MOF as of 26.5.2016), constituting 3.8% of the total value of agricultural output. Setting reduced fuel excise duties does not refer to the environmental aspects, it is a de minimis state aid to farmers. Diesel fuel excise duty rates and proposed changes in the duty rates are presented in Table 4.2.

**Table 4.2. Diesel fuel excise duty rates in Estonia (actual rates in 2016, proposed rates for 2017-18) and in the EU, euros/1000 l**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Energy product | Excise duty rate in euro | | | Minimum rate in the EU in 2016 |
| From 2016 | From 2017 | From 2018 |
| Diesel fuel | 448 | 493 | 542 | 330 |
| Diesel fuel for specific purposes | 121 | 133 | 146 | 21 |

*Reduced excise duty rates for individual small breweries*

1. The rate of excise duty on beer produced by small breweries whose production volumes do not exceed 3,000 hectolitres per calendar year is 50 per cent reduced of the regular rate of excise duty (see Table 4.3). The exemption of excise duty of small breweries was 0.2 million euros in 2015, an increase of 50% is projected for 2016 (Ministry of Finance, as of 26.05.2016).

**Table 4.3. Excise duty rates on beer in Estonia and the minimum excise duty rates in the EU**

|  |  |  |  |
| --- | --- | --- | --- |
| Volume of production, l | Unit | Duty rate in euros 1.02.2016 | Minimum excise duty rate in the EU in euros |
| >300,000 | 1% by volume of ethanol in 100 litres | 8.30 | 1.87 |
| < 300,000 | 4.15 | 1.87 |

*Packaging Excise*

1. Excise duty on packaging is imposed on all packaging brought to the Estonian market. Excise duty on packaging filled in Estonia shall be paid by the person, who brings the packaged goods to the Estonian market for the first time and makes these available for distribution and use. Total relief from excise duty is granted to:

* beverage packaging, to which the deposit has been assigned and whereof at least 85% of every class of packaging material is recovered;
* metallic beverage packaging, whereof at least 40% is recovered
* other packaging, that is recovered to the provided rate.

1. Pursuant to the Packaging Act, as of 1 January 2009, the packaging undertakers shall be obligated to recover the packaging material annually at least to the following extent:

* by way of recycling, 70% of the total mass of glass waste;
* 70% of the total mass of paper and cardboard waste, whereas 60% by way of recycling;
* by way of recycling, 60% of the total mass of metal waste;
* by way of recycling, 55% of the total mass of plastic waste, whereas 45% by way of recycling, and 22.5% by way of recycling it into new plastics;
* 45% of the total mass of wood waste, whereas 20% by way of recycling thereof.

1. The payer of excise duty has the right to transfer its recycling and excise obligations to an accredited recovery organisation. Exemption from excise duty on packaging is applied on the entrepreneurs whose packaging amounts are small and the mass of plastic packaging does not exceed 25 kg in a quarter, and packaging of other material 50 kg in a quarter.
2. Upon imposing excise duty on packaging, first and foremost, the actual results of recovery are taken into account. The payer of excise duty that has failed to meet the rates of recovery has to pay excise duty for the deficit quantity of packaging.
3. From 2012 agricultural plastic (bale plastic wrap, silage cover, tunnel plastic, plastic mesh and plastic twine) is not subject to packaging excise. The packaging undertaking who sells packaged goods to the end user or consumer is obliged to collect the farm plastics waste from the agricultural producer without any possibleadditional administrative burden.

### Impacts (measured or potential) of tax arrangements (general or agriculture-specific) on the environment, the use of natural resources and the resilience to climate change; types of incentives that lead to such impacts

*Environmental charges and fees*

1. For the purposes of Environmental Charges Act, ‘environmental charge’ is the price of the right of use of the environment. ’Environmental use’, which is burdened with the tax includes:  
    1) regeneration cutting of forest stands;  
    2) extraction of mineral resources;  
    3) water abstraction;  
    4) fishing;  
    5) hunting;  
    6) emission of pollutants into the ambient air, water bodies, groundwater or soil;  
    7) waste disposal by way of depositing in landfills or other activities that result in the discharge of waste into the environment.
2. Arus (2016) investigated the links between the pollution tax levels pollutant emissions in Estonia in 2008-13. The analysis revealed that the impact of pollution tax levels varied with different pollution charges. Air pollution charges as a whole have not led to a marked fall in pollutant emissions, and the public sector has been receiving growing amounts of environmental taxes at their expense. Quite the opposite rings true for the water pollution taxes: increasing tax rates have reduced pollutant emissions. Waste pollution charge rates have risen more slowly than the reduction in the quantities of waste, resulting in a decrease in pollution tax revenues to the public sector.
3. The environmental charges are divided into the natural resource charges and the pollution charge. Natural resource charges are paid at the rates established on the basis of this Act. The situation, place of use, quality and deficiency of the reserves of natural resources, the environmental hazards of the manner of use and the need to protect other natural resources are taken into account upon establishment of charge rates. The pollution charge is paid at the established pollution charge rates. The sensitivity to pollution of the emission site, the hazardousness of the pollutant and the use of the best possible technology are taken into account upon establishment of the charge rates.
4. Agricultural producers who have been granted the following permits are subject to the environmental charge:

* integrated environmental permit (including the water abstraction permit and ambient air pollution permit);
* water abstraction permit for the right to abstract water;
* water permit for the right to discharge waste water into any receiving water body;
* ambient air pollution permit (Heinma 2014).

1. In 2013, the pollution charges from agriculture, forestry and fishing activities amounted to 458,000 euros and fees for use of natural resources 1,847,000 euros, whereas in food and beverage industry pollution charges accounted for 279,000 euros and fees for the use of natural resource 504,000 euros (Statistics Estonia KK35).
2. The Ecological Tax Reform, launched in Estonia in 2005, provided for an increase in environmental fees, and the environmental charges have been consistently on the rise since the beginning of the reform. Estonian statistics classifies environmental charges as environmental taxes. The environmental taxes laid down in the tax laws are fuel excise duty, heavy goods vehicles tax and packaging excise duty. The structure of environmental taxes and charges is different from the one in use in the rest of the EU – the share of transport taxes in environmental taxes is the smallest. Estonia has not imposed such wide-spread transport taxes that have been established in other EU countries, as annually paid car fee and toll on roads.
3. In the past two years the impact of environmental taxes and charges has not been analysed. The latest study based on the survey data of 2000-10 dates back to 2013 (Environmental Charges Impact Analysis. Sustainable Estonia Institute (Stockholm Environment Institute Tallinn Centre in collaboration with the Centre for Applied Social Sciences (CASS) of the University of Tartu). The Environmental Charges Impact Analysis (2013) states that:

* impact of the ambient air pollution taxes on the reduction of the emissions of pollutants from a stationary source or on the quality of the ambient air in Estonia is low;
* the impact of mineral extraction fees aimed to motivate companies to mine and use mineral resources in a more efficient way is weak or there is no effect at all, because the changes in mining volumes and losses occur regardless of the increase in the pollution tax rates;
* from special water abstraction charges have generally increased, but trends in the amounts of water used vary by abstraction and fields of use, and the correlation with elevated environmental charges could not be established;
* the respondents stressed that, as compared to environmental charges, direct environmental requirements, which set the criteria for obtaining licenses and rates for fines, as well as the need to save resources for cost saving purposes, are far more powerful motivators.

### Tax incentives for private investment in R&D; specific tax incentives for companies adopting innovation

*Tax Incentives to Support R&D*

1. The study conducted in 2009 by KPMG Baltics LLC, PRAXIS Centre for Policy Studies and Karsten Staehr (PhD) “An Analysis of Tax Incentives to Promote Research and Development in Estonia” made the following suggestions:

* The withholding income tax rate for R&D employees should be reduced to 10%.
* Social tax rate should be reduced to 15% for R&D employees.
* Any monthly income in excess of either EUR 500, EUR 400 or EUR 300 should not be subject to social tax.

Two possible alternatives:

* Social tax is capped at EUR 1,000 in absolute value (meaning EUR 3,000 salary with 33% social tax rate) for imported R&D employees, who spend 3 years in Estonia. After 3 years, the social tax is 33%.
* Any annual income in excess of double of the annual average wage (EUR 17256) is not subject to social tax. (An Analysis of …)

1. None of the suggestions were put into practice. Teder (2014) has pointed out that as the aim is to enhance knowledge-based Estonian economy, tax incentives could be applied for research intensive enterprises to ensure a net increase in salary to top researchers and top specialists. The suggested tax incentives included reducing the personal income tax and the social tax. With regard to tax breaks, the Minister of Finance (in 2014) was of the opinion that at corporate tax level enterprises were enjoying tax reductions already and the introduction of tax incentives on individuals would call for control exerted by the Estonian Tax and Customs Board to identify whether the activities fall into the category of research development or not.
2. In 2014, there were two EU member states, Estonia and Germany, which lacked a tax policy directly stimulating innovation (A Study ...). In Estonia, still no tax rules providing incentives to innovation have been introduced. Currently, both the Estonian tax and national support system, favour capital investments. The present Estonian tax system stimulates the volumes of external funding rather than the investor’s initial decision to make the investment and does not contribute to attracting higher value-added investments (innovation, knowledge-based and higher-productivity investments) to Estonia. Investments into intellectual property and creating ‘smart jobs' still calls for greater attention from the tax policy point of view. (Made in Estonia 3.0)

## Summary

* Estonia pays a lot of attention to the compliance of food production with the EU and national regulations. Food safety and food quality are one of the most important activities of the MRA, starting from the development of requirements and legislation to the national food chain control and supervision.
* Food production requirements (including support eligibility requirements) call for adaption on the part of producers, which contributes to the development and adoption of new technologies and production practices.
* Ensuring a clean living environment, raising the environmental awareness of the society, preservation of natural heritage and the sustainable use of natural resources is the main goal of many national and international environmental strategies, plans and agreements (that Estonia has joined).
* In the taxation policy, the government’s goal is to shift the tax burden from taxation of income to taxation of consumption, use of natural resources and pollution of the environment. At the same time, the government attempts to keep the system simple and transparent with as few exceptions and differences as possible. That is also the reason why there are no essential tax exemptions for the agriculture and food sector. Integrating tax exemptions into a simple taxation system is complicated.
* In Estonia no tax advantages have been introduced on R&D investments. The exclusive corporate tax system valid in Estonia, where profits are not taxed until their distribution, acts as an economic tax incentive.
* Three objectives mentioned in the action plan of the Estonian Government (04/08/2015) are related to the topics above (the Government of the Union ...)
  + Improve tax collection without disproportionately increasing the administrative burden of businesses in the interest of economic growth and fair competition;
  + Refrain from the taxation of investments;
  + Analyse the possibility to impose excise duties on energy drinks.

# 5. Capacity building and services for the food and agriculture system

## Infrastructure and rural development policies

*Investments in physical and knowledge infrastructure, from ICT to transportation facilities, are important for overall growth and development. They are vital to the delivery of and access to important services and play a critical role in linking farmers and related businesses to markets, reducing food waste, boosting agriculture productivity, raising profits, and encouraging investment in innovative techniques and products. Productive and profitable enterprises may have higher incentives to invest in sustainable practises that yield long term benefits.*

*Broader rural development measures also affect sustainable agricultural development and structural adjustment. Increased off-farm income and employment opportunities mitigate farm household income risks, facilitate farm investment, and enable a wider range of farm production choices. Improved rural services, from banking to ICT, are important to ensure needed connectivity to suppliers, customers, and collaborators. Rural policy can also attract innovative upstream and downstream industries, with possible spill-over effects locally. By reducing inequalities in economic development and access to services across regions, rural development policies improve the diffusion of innovation.*

### Adequacy of physical and ICT infrastructure to the needs of environmentally-sustainable economic development, in particular with respect to the food and agriculture sector

1. According to the WEF GCI, total index of transport infrastructure in Estonia is lower (4.0) than the OECD countries’ average (4.9, Figure 5.1.A). The quality of overall infrastructure in Estonia is quite similar to the average of OECD countries (Figure 5.1.B). The port infrastructure is the best quality (5.5), being better than the OECD average (5.1), and slightly lower than the OECD top 5 (5.7). But the railroad (3.9) and air (3.7) transport infrastructure are very low. The low index given to air transport can be explained by the low number of connections to Europe and other continents, as well as the constantly varying destinations. The reason for the low index for rail transport is also the scarcity of international connections and the speed of passenger train traffic of up to 120 km/h on reconstructed rail sections. Although the real speed of the new passenger trains purchased in 2013 is up to 160 km/h, the railway infrastructure in Estonia is not ready for such high speeds. At the same time, the rails and rail sleepers on the main lines of the public railway network have been renovated for the most part. (MEAC, 2013c)
2. The physical infrastructure in Estonia is relatively good, but there are some problems with the availability and quality of infrastructure, especially in rural areas. As to the comparison of roads types, it can be said that main roads are mostly in a good or very good condition, basic roads in a satisfactory condition, whereas the secondary and local roads are in a rather poor condition (MEAC, 2013c). In 2015, 68.2% of the national roads (main, basic and secondary roads) were paved (Road Administration, 2015). The rest of the state roads are gravel or earth roads. Local roads (except streets), are mostly unpaved, or light-surfaced roads (MEAC, 2013c). The low quality of roads is related to the scarcity of funding.
3. Technological adoption in Estonia is similar to that of the OECD average (5.8, Figure 5.2.A). Scores for mobile telephone subscriptions are very high (4.9, Figure 5.1.B) and for internet use relatively high (80% of individuals use internet, in high income OECD countries the figure is 81%). The indices for fixed telephone lines and the quality of electricity supply are lower than the OECD average.

**Figure 5.1. Index of Transport Infrastructure, 2015-16**

**A. Total index of transport infrastructure, 1-7 (best)**

**B. Estonia’s index of transport infrastructure, by component, 1-7 (best)**

Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Netherlands, Japan, Spain, France and Germany).

Indices for EU28 and OECD are the simple average of member-country indices.

Source: World Economic Forum, The Global Competitiveness Report 2015-2016.

**Figure 5.2. Index of Electricity and Telephony Infrastructure, 2015-16**

* 1. **Total index of electricity and telephone infrastructure, 1-7 (best)**
  2. **Estonia’s index of electricity and telephony infrastructure, by component, 1-7 (best)**

Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Switzerland, Luxembourg, Austria, United Kingdom and Iceland).

Indices for EU28 and OECD are the simple average of member-country indices.

Source: World Economic Forum, Executive Opinion Survey (The Global Competitiveness Report, 2015-2016).

1. Almost all companies use computers and almost all enterprises have broadband Internet connection (Figure 5.3). In 2005, the share of enterprises using computers and broadband Internet access in the agricultural sector was slightly lower, as compared to other sectors, but by 2016 these differences became non-existent. In manufacturing industry (including food industry), the use of computers and fixed broadband access has been higher than the average through the ages. In 2016, 79.0% of the agricultural enterprises had DSL technology (Digital Subscriber Line: ADSL, SDSL, etc.) installed, which enables to provide high-speed internet services over a telephone line. The bitrate at 44.8% of agricultural enterprises was 10-30 Mbit/s, and at 39.5% up to 10 Mbit/s. The websites of agricultural enterprises included product catalogues or price lists (98.8%), as well as information about job vacancies (17.3%), and links or references to the company's social media profile (15.0%).

**Figure 5.3. The share of enterprises using computers and having a broadband Internet connection, 2005-16 (%)**

Source: Statistics Estonia [IT004]

1. Since 2010, Estonia has been rapidly developing the basic broadband infrastructure (passive optical network) with the EU support with a view that around 98% of residences and businesses are within 1.5 km of the nearest connection point (MEAC, 2013a). By autumn 2016 4,000 km of EstWin broadband network had been installed (ELASA, 2016), which has contributed to the development of 4G internet and will support the development of 5G internet in the future. Unfortunately, the development of basic broadband infrastructure has not significantly increased the number of users. In Estonia, people are using fast and ultra-fast internet through fixed network. The problem lies in making high-speed broadband access to the Internet network accessible to the end uses. Communications operators do not have economic interest in developing it. In order to achieve this goal, the plan was to develop a contemporary fibre optic cables based Network from the broadband network to the end users in sparsely populated areas with a limited number of end users. As of autumn 2016, only 10% of the fibre optic capacity of basic broadband infrastructure was exploited (it is possible to use OC24 or OC48 throughout the entire passive optical network). Telecommunications companies investing in the development of mobile Internet and offering their clients 4G Internet have benefited the most from the development of the basic broadband network. It is not an equivalent replacement for cable connections, but has still offered a partial solution to the problem. (National Audit Office, 2015)
2. The electricity and gas supply interconnections in Estonia are, first and foremost, linked with the connections with Russia, other Baltic countries and Finland (only electrical connection). Connections with the other EU Member States are not available (MEAC, 2013c). 85% of the electricity in Estonia is produced from oil shale. There are no nuclear power plants in Estonia. In some small islands like Ruhnu and Naissaare off-grid solutions (i.e. without any connection to the electricity grid) are used. An off-grid solution consists of a renewable power plant, a storage battery and an inverter that changes the DC power to AC energy. The electricity network company is considering expanding the same solution to sparsely populated areas where the clientele with low power consumption live. (Timm, 2016)
3. Estonia is located in a temperate climate zone, where the amount of precipitation significantly exceeds total evaporation. Humid climate, flat terrain, unevenly distributed natural hydrological network and soils with poor permeability contribute to widespread paludification. That is why land improvement systems form an integral part of farming. 55% (522,000 ha) of the UAA is covered by land drainage systems. Most of the drainage systems are over thirty years old and need reconstruction. In 2005, 26% of the draining systems were in a poor condition. The EU subsidies paid out between 2004-13 allowed to reconstruct about 15%, and renovate about 25% of the drainage systems in need of repair on agricultural land. Support for the reconstruction and renewal of land drainage systems is continued in 2014-20. According to the Register of Land Improvement Systems, irrigated areas make up 0.03% of the total agricultural land. The construction of combined drainage irrigation systems (double-duty systems) is gaining more and more popularity. Such systems secure a sufficient amount of water for the plants in dry periods, ensuring at the same time that water is not wasted. (MOA, 2015a)
4. The development and reconstruction technical infrastructure is carried out in an environmentally friendly manner and in line with the environmental legislation.

|  |
| --- |
| Box 5.1. The status of the technical infrastructure through the eyes of rural entrepreneurs and local authorities A well-developed infrastructure in rural areas helps to compensate for the distance between rural areas and major attraction centres. Entrepreneurs consider the availability (with sufficient capacity) and fault tolerance of the energy, availability and quality (speed) of communications infrastructure, water quality and the state of the roads the most essential factors of the business environment.  The condition of infrastructure in rural areas of Estonia varies a lot. Out of the technical infrastructure elements, the entrepreneurs rank the condition of local roads as the worst. The representatives of the processing industry estimated the condition of roads to be better than the entrepreneurs from the primary sector.  According to local authorities, the biggest problem is the poor technical quality of electricity supply network and the excessive pricing of grid connection and electricity capacity upgrading. The state of the roads and the availability of adequate electric power supply was rated the worst by the entrepreneurs in South Estonia.  Source: Estonian University of Life Sciences (2012). The study, "The situation of rural enterprises, their development trends and the need to support." Final report. Tartu. |

### Priorities of infrastructure development, their focus on agriculture and agri-food needs, and facilitation of efficient use of resources

1. The priorities for the development of infrastructure are reflected in a number of development documents, which preparation and implementation is primarily the responsibility of the MEAC. All documents are, to a greater or lesser extent related to the development of agricultural and food sectors. Transport development plans highlight efficiency and environmental sustainability. The Estonian Transport Development Plan 2014-20, adopted in 2013, emphasises the maintenance of the conditions of the main roads and the improvement of secondary and side roads as (including paving all major state gravel roads, which frequency exceeds 50 cars a day, by 2030), reducing car use in towns, increasing the number of train connections and train speed, increasing traffic safety, raising the share of economic vehicles and cars running on renewable energy cars as their highest priorities. The main alternative type of fuel would include biomethane produced from domestic waste or biomass, and compressed gas. (MEAC, 2016)
2. The Estonian National Development Plan of the Energy Sector Until 2020 was established to guide, besides other sectors, the development of agricultural and food sector as well. The principal goal of the Plan is to make energy production more environmentally friendly and the energy portfolio more diversified (MEAC, 2013b). The Plan includes the Estonian National Renewable Energy Action Plan until 2020, which endeavours to reach a level where the energy produced from renewable energy sources would account for 25% of the gross final energy consumption (MEAC, 2010). The same document contains, among other things, measures that are aimed at increasing biomass availability, taking into account other biomass users (including agriculture). The Estonian Energy Sector Development Plan Until 2018 is linked to the Energy Sector National Development Plan and its objective is to ensure a consistent and sustainable supply of electricity at a justified price in Estonia. At present, the MEAC is working on the elaboration of a new Estonian National Development Plan of the Energy Sector Until 2030, which is aimed at ensuring an energy supply that is available to consumers at a reasonable price and effort and with an acceptable environmental impact, while observing the terms and conditions established in the long-term energy and climate policy of the EU. The most beneficial economic competitiveness aspects must be observed for the purposes of the implementation of National Development Plan of the Energy Sector Until 2030. The new plan also drafts the benchmarks for renewable energy, energy efficiency operational programmes and the vision for the renovation of buildings. (MEAC, 2016)
3. The goal of the Estonian Maritime Policy 2012-2020 is to use and maintain Estonia’s marine resources as much as possible and contribute to the development of marine sector (MEAC, 2016).
4. Digital Agenda 2020 for Estonia is the key instrument in the field of information and communication technologies (ICT). The development plan provides the guidance for creating a well-operating national information and communication technology environment. The main goals include an ICT structure that fosters economic growth, national development and the welfare of its population, increased number of jobs with higher added value, improved international competitiveness and a higher quality of life, smarter governance and increased awareness of e-governance in the world (MEAC, 2013a).

### Funding of infrastructure development; provision of incentives to private investors in infrastructure projects through, e.g. grants, tax concessions, public-private partnerships, etc; guidelines for governance of public-private partnerships for infrastructure projects

1. Since joining the EU, the following EU Structural Funds have been used for the development of transport infrastructure:

* The Cohesion Fund (CF) is used to finance major transport and environmental infrastructure projects that cost over 10 million euros. In the transport sector it is possible to apply for grants of up to 85% of the total project costs for those roads, which belong to the pan-European transport network TEN-T (RA 2016).
* The European Regional Development Fund (ERDF) supports infrastructure projects that contribute significantly to innovation, telecommunications, environment, energy economy and transport (EUSAE, 2016). In infrastructure projects, the EU contribution rate is 75% of the project cost, plus 25% of the national co-financing.

1. Transport projects involve the investments of the private sector. The largest public-private partnership (PPP) project in Estonia is related to the reconstruction and maintenance of the Mäo-Kose section of the Tallinn-Tartu-Luhamaa highway in 2011. This was the first PPP project meeting the international standards in the in Estonia. In Estonia, the principles of PPP are not applied in road construction. An analysis on the application of PPP in road construction, conducted in 2011, led to the view that considering the size of Estonia, it is cheaper for the state to invest in road construction themselves than do it within the framework of PPP.
2. Energy operators are granted support for the application of renewable energy sources on the basis of Electricity Market Act, liquid fuel producers on the basis of the Alcohol, Tobacco, Fuel and Electricity Excise Duty Act, and in district heating economy from the EU structural funds (ERDF), as well as from other sources. Electricity infrastructure is financed from the electricity transmission fees or tariffs. (MEAC, 2010)
3. In the period 2012-2020 investments in port infrastructure account for more than half of the total cost of maritime activities (534 million euros). The investments are co-financed by the EU funds. (European Maritime and Fisheries Fund, MEAC, 2012)
4. High-speed broadband access and greater usability is supported from the ERDF, the EAFRD, and by the state.

### Institutions, policy and market mechanisms that manage access to infrastructure or resources

1. In enterprise development, the existence of the necessary infrastructure and its accessibility (including connection fees) is of utmost importance. Similarly to the rest of the world, network services are primarily provided by one network operator, whose operations and service costs are under the state control (Electricity Distribution, 2016). Fee for the connection to the electricity network for business customers depends largely on the chosen amperage and on the distance of the consumption point from the nearest substation. The results of the survey have shown that the most problematic issue for the businesses in rural areas is the electricity network connection fee and the too high a price on the increase of capacity in case of expansion. Local authorities consider the price unreasonably high for businesses, and this can become a major obstacle to the development of entrepreneurship (EMU, 2012).
2. The areas of operation of public water and sanitation service suppliers are determined at the municipal level. The fee for the connection to the public water supply and sewerage system is established by the local council that has the power to impose the capping rate on the connection fee. The water company is responsible for calculating the connection fee to public water and sewerage system. (PWSSA, 1999) Service suppliers may also offer a connection to the system at an advantageous rate in case the construction and restoration of the water supply and sewerage system has been funded by the EU Cohesion Fund.
3. As a part of different ad hoc investments, the Estonian RDP 2014-20 allows to build electric, water supply and sewerage systems and connect to the necessary systems. In case of investment measures targeted at agricultural producers and food processers, investments are eligible expenses (MRA, 2015).
4. Thanks to the rapid development of mobile network, internet is conveniently accessible. Gradually a new generation of broadband services is expanded to the areas of market failure. The construction of access networks to broadband telecommunications network is not profitable for operators. Therefore, different support measures have been launched to roll-out the network. In South Estonia, the construction of the access network has been supported by the ERDF and the state. Estonian RDP 2014-20 allows to build access to broadband telecommunications network. Such investments are eligible in the framework of the LEADER programme and other investment measures targeted at agricultural producers and food processers investments (MRA, 2015).
5. Natural gas is mainly consumed by industrial companies and distributed by a distribution system operator, whose activities and service fees (including connection fee) are under the state control.
6. Road toll charges are not implemented in Estonia.

### Ease of access to information about market developments, technical options and weather for producers and other actors in rural areas

1. Thanks to IT development and the everyday use of IT technology, farmers and food processors have a very good access to information concerning market developments, technical possibilities and the weather. E.g., one of the services on offer is field based weather forecast, which enables the farmers to plan their fieldwork according to the weather conditions and thus increase their operational efficiency (Vitalfields). Farmers also receive a lot of information (on the equipment, technology, etc.) from vendors and distributors. Information on market developments can be obtained from seminars and panels organised by producer organizations.

### Sufficiency of public services in rural areas for maintaining and attracting people and businesses

1. Estonia is characterized by urbanization (63% of the population lives in urban areas), and suburbanization. In the context of ensuring the regional balance, the problem is that 40% of the Estonian population is concentrated in the capital city and in the small towns and municipalities surrounding the capital. Urbanization and population concentration in Tallinn and the surrounding municipalities has led to the aggregation of services, including public services, to the regional centres, instead of rural municipality and county centres, which has worsened the physical accessibility and the quality of services in rural areas. On the other hand, the volume of certain physical public services has been reducing due to the spread of internet, improvement of computer skills and the development of public e-services.
2. Estonia stands out for the use of electronic ID, which makes it possible to make administration practically paper free, fast and flexible. The development of the e-government, especially the elaboration of e-services for the public sector and their application by the citizens and enterprises has so far been the strength of the national ICT policy (distributed services-based architecture, web-based/online services, orientation towards e-services, etc.). The basic or service infrastructure of the state information system (X-way, public key infrastructure and e-ID, document exchange centre, information gateway eesti.ee) has over the years supported the development of public services quickly and flexibly through ICT solutions (MEAC, 2013a). In this respect, it should be noted that there are problems with modern Internet connection in sparsely populated rural areas, which means that there are also problems with the accessibility of e-services for both the residents and entrepreneurs. Digital Agenda 2020 aims to tackle this market failure.
3. In addition, NGOs (third sector) and the local authorities in Estonia cooperate to offer public services to the population. The public services most delegated to the NGO-s are in the fields of culture, leisure, sports and the promotion of regional life (Uus et al., 2014). It is a new phenomenon in the rural areas to offer community services to other members of the community for a nominal charge.

## Labour market policy

*Labour market policy influences employment composition and labour mobility, in particular by facilitating (or discouraging) labour to adapt to new circumstances. It can play an important role in facilitating structural adjustment, including farm consolidation, by assisting excess labour in farming to exploit more remunerative non-farm income and employment opportunities. Policies on skills improvement and on international mobility of human resources can also help to better match labour supply with demand, and can affect innovation and knowledge transfer through exchange of skills and skilled labour. Structural adjustment allowing younger and better educated farmers to enter the sector, and skills improvement policies are expected to improve the adoption of sustainable practices.*

### Labour market legislation: facilitation of adjustment to new opportunities, protection of employment and labour conditions

1. Demand for labour could be affected by the stringency of employment protection laws. The more stringent the laws are, the higher are the employers’ anticipated costs in creating jobs. Estonia is the only Baltic state, where employment protection was significantly loosened by the 2009 Employment Contracts Act (Labour Market Review 2016 ...). One of the aims of the Act was to increase flexibility, which means that labour regulation must allow the parties to agree on the conditions of industrial relations that would recognize the needs and interests of the contracting parties in the best possible way. However, at the same time the act aimed to ensure the protection of the social partners by laying down the minimum conditions. The implementation of the 2009 Employment Contracts Act drew the following conclusions (Masso et al 2013):

* It has been possible for the employers to cut salaries or leave them unchanged in the changing economic environment, which supports the view that wages are flexible.
* Since the workers’ knowledge and skills influence their chances of finding a job and create added value through work, education and labour policies try to motivate the social partners to develop workers’ skills and knowledge. According to statistics, the proportion of employees involved in formal education and professional training has not changed in conjunction with the changes in business environment after the adoption of the Act. The new law allows the employers to manage the risks associated with the costs of training staff by concluding an agreement for the reimbursement of training expenditure. The employer and the employee may agree that if the employer incurs additional costs for training the employee, as compared to the reasonable expenses for training the employee, the employee will work for the employer during an agreed period of time to compensate for these costs.
* The Act reorganized the regulation of working time with the purpose of protecting the workers’ health. Statistics shows that the average length of the working time and the proportion of employees doing long hours has not changed after the adoption of the Act.
* The proportion of employees working overtime, as well as the average amount of weekly overtime has remained the same. An employee is expected to work 40 hours in a seven-day period (full-time), unless the employer and the employee have agreed on a shorter working time (part-time work). In the case of calculation of the summarised working time, overtime work means work exceeding the agreed working time at the end of the calculation period. The analysis did not identify any significant changes in the overtime compensation procedures over the past years, although the new act requires that the employer should compensate for the work by paid time off equal to the overtime.
* Compared to the previous law, the new act gave the employee the right for paid time off, if the employee cannot perform work due to a reason arising from the employee, but not caused intentionally or due to severe negligence or if the employee cannot be expected to perform work for another reason not attributable to the employee.

1. Estonia’s Index of labour market efficiency for the cooperation between enterprises is higher than the OECD countries, average (Figure 5.3).

**Figure 5.3. Estonia's Index of labour market efficiency by component, scale 1 to 7 (best)**

Note: OECD top 5 refers to the average of the scores for the top 5 performers among OECD countries (Switzerland, United States, United Kingdom, New Zealand and Canada

Source: World Economic Forum, The Global Competitiveness Report 2015-2016.

1. Wage flexibility is, however, considerably higher than the OECD average, as well as that of the top 5. Hiring and firing index is higher than the OECD average but lower than that of the top 5. Redundancy costs are at the OECD average level. The effect of taxation on the incentive to work is slightly higher than the OECD average, but remains below the level of the top 5. The link between the salary and productivity in Estonia is above the OECD average. The relation between labour costs and productivity is good, but as the pressure on salary increase has been high, and the wages have gone up faster than productivity, this indicator is expected to move downwards in the future. Professional management index is at the level of the other OECD countries, but Estonia’s ability to retain and attract talent is significantly lower than the OECD average, and compared to the top 5, Estonia’s indicator is very low. At the same time, however, the proportion of women in the force is high. Thus, the Estonian labour market stands out primarily by the flexibility of wage determination and a high proportion of women in the labour market and from the social point of view, it would be important to deal with the retaining and attracting talents.
2. Lithuania’s regulations concerning temporary work have been acknowledged as the highest among labour protection indicators (Figure 5.4), followed closely by the corresponding indicator of Estonia. Protection against dismissal is rated as close to the OECD average.

**Figure 5.4. Employment protection indicators in selected counties (2013), scale 1 to 6 (higher protection)**

Source: OECD/IAB Employment Protection Database, 2013 update.

<http://www.oecd.org/els/emp/oecdindicatorsofemploymentprotection.htm>

1. GDP per worked hour has been selected to describe labour productivity (Figure 5.5). Out of the selected countries, labour productivity is the highest in the Netherlands, Denmark, Sweden, Finland and Canada, where the GDP per hour worked has increased steadily in the years under examination. Estonia's labour productivity is in the same group with that of Poland, Lithuania and Latvia, where the GDP per hour worked was about 15 USD in 2001, and by 2014 had reached around 30 USD, i.e. it had doubled in the years under review.

**Figure 5.5. GDP per hour worked, USD, current prices PPP in selected countries, 2001-14**

Source: OECD statistics

1. Personnel costs consist of wage and non-wage costs, such as employers' social contributions. In Estonia, wage labour costs make up 73.3%, and non-wage account for 26.7% (How large ...) The share of non-wage labour costs in all sectors of the EU28 economy was 24.4%, and 26.1% in the euro area as a whole. The share of non-wage labour costs in all sectors of the economy were the highest in France (33.1%), followed by Sweden (31.6%), Italy (28.2%), Lithuania (28.0%), Belgium (27.8%) and the Czech Republic (27.1%). The share of non-wage costs was the smallest across all sectors of economy was the lowest in Malta (6.9%), Denmark (13.1%) and Ireland (13.5%) (Wage and labour costs in 2016). Thus, the share of non-wage labour costs from total wages in Estonia is of the EU average.
2. Figure 5.6 describes hourly labour costs in the selected countries. Hourly labour costs are the highest in Denmark, Sweden, Finland and the Netherlands, whereas hourly labour costs are the lowest in the Czech Republic, Estonia, Latvia, Lithuania and Poland.

**Figure 5.6. Hourly labour cost in selected countries 2003-12, euros**

Source: Eurostat

1. Figure 5.7 presents the growth rate in the unit labour costs (ULC) in terms of nominal value. ULC should not grow rapidly as it measures the cost of labour per creating one unit of GDP and, in addition it represents a link between productivity and the cost of labour in producing output (Mertsina 2012).

**Figure 5.7. Unit Labour Cost, Total economy, annual growth rate in selected countries 2001-12**

Source: OECD statistics

1. The figure shows a sharp increase in the ULC in Estonia over the period 2006-08 as compared with other selected countries. No other country reached the similar result at the height of the business cycle as Estonia, although the increase in ULC of Poland amounted to nearly 8% in 2008, and that of Finland to even 10% in 2009. A sharp increase in the ULC creates unemployment as companies are not able to pay high wages to everybody and as a result the competitiveness of the country reduces and economic growth slows down. However, the growth of ULC stabilised between 2011 and 2012 as the productivity increased. Total labour costs across all fields of activity and in agriculture changed at the same pace in the years under observation, even though in 2008 labour costs in agriculture, forestry and fisheries increased by some 10% more than in total economy, but the reason for this lies in the economic cycle.
2. ULC in real terms has increased steadily over the period under examination. Only in 2008, did the ULC increase faster as compared to other years, but this can be explained by the overall rapid growth of the economy. After 2008, the growth in the ULC started to slow down, which was rendered possible through the growth in labour productivity. In 2014 and 2015 the ULC have begun to grow again, because the wages have grown faster than labour productivity (Figure 5.8). Decrease in the labour productivity, however, is related to the cheaper labour in Estonia as compared with neighbouring countries, which attracts new companies, but does not create an incentive for the technology-intensive investments and the creation of smart jobs, and prevents the growth of.

**Figure 5.8. Labour productivity per employee. Unit labour cost in Estonia, changes in real terms as compared to the previous period, 1996-2015, %.**

Source: Statistics Estonia [RAL0013]

### Initiatives to create new jobs and assist labour adjustment from declining to growing sectors

1. Unemployment Insurance Fund has a number of programmes that allow the creation of new jobs and further training for better participation in employment. For example, the program “Provision of labour market services to facilitate employment opportunities” and “Provision of labour market services to the target group of work reforms”. The unemployed registered with the Unemployment Insurance Fund can participate in the training sessions. It is also possible to get a business start-up subsidy, which is financial aid (in 2016 up to 4,474 euros) aimed at providing motivation and support in starting a business as a start-up or a sole proprietor. (The Unemployment Insurance Fund ...)
2. Estonia has initiated a number of projects to solve the problems. For example, to attract talent the Estonian Chamber of Commerce and Industry launched the “Bringing talent home” project in 2010, which endeavours to bring together employers in Estonia with talented young people who have gone abroad to study or work (Bringing talent home 2016). Since it is difficult to find skilled workforce in in rural areas, a citizen initiative “Come to live in the countryside” was launched. The initiative has a website that allows to find jobs and housing in the countryside, as well as find opportunities for entrepreneurship.

### The role of migration rules in ensuring meeting labour market demand; encouragement of skilled labour inflow; provisions for farm operators and workers

1. Although the movement of labour is easier within the EAA, there are problems with migrant workers from the third countries, who are subject to strict rules and regulations. As a rule, third country nationals must seek a residence permit to enter the labour market in Estonia. An annual immigration quota that should not exceed 0.1% of the permanent population of Estonia per annum is set for aliens immigrating to Estonia (Aliens Act § 113). For this purpose, permission must be granted by the Estonian Unemployment Insurance Fund and the wage criterion fulfilled. This means that the employer is required to pay remuneration amounting to 1.24 times the average annual wage published by Statistics Estonia (Recruiting from abroad ...). As the wage coefficient for third-country workers coming to work in Estonia will be reduced from 1.24 to 1.0, the situation with seasonal workers in agriculture is expected to relax.
2. The average gross monthly wage has generally followed an upward trend, and although there was a slight setback in 2009, the average monthly gross wages began to rise in 2010 and increased to 1065 euros by 2015 (Figure 5.9). At the same time, the wages in agriculture, forestry, and fishing constituted 82% of the average gross wages in 2008 and 89% in 2015. Thus, the gap between the Estonian average gross wages and the gross wages paid in agriculture, forestry and fishery is narrowing, suggesting that the difference between the labour productivity in agriculture and the economy-wide average is decreasing.

**Figure 5.9. Estonian average monthly wage and the average monthly wage in agriculture, forestry and fishery**

Source: Statistics Estonia [PA5211]

1. Since it is not easy to enter the labour market in Estonia, it is also reflected in the relevant official statistics. The share of immigrant population employed in agriculture is only 1-2% (Statistics Estonia).

Horticultural producers, who wish to alleviate the terms for recruiting temporary seasonal workers from the third countries, have been most active in fighting against the present migration conditions, which are currently forcing the employers to pay migrant workers in Estonia a higher salary that is paid the seasonal workers, for example, in Finland. Due to its specifics, horticulture is a very labour intensive branch of agriculture. Since the emigration of people from Estonia continues and the state policy does not favour the recruitment of temporary work force from the third countries, horticultural producers are due to the shortage of workforce struggling with the harvest. For example in strawberry cultivation alone, it would be possible in the peak season to offer a temporary assignment to an additional 200 temporary employees (Gardening people ... 2014).

1. However, by May 2016 the Governments has started to take steps to abate the law. Namely, the government approved and sent to the Parliament a draft decision which obliges employers to pay foreign workers the wages equal to at least the average salary in Estonia. In addition, two EU directives (the periods prescribed for their implementation are not over yet, thus their impact cannot be assessed. The transposition date for the 2014/36 is 30.09.2016 and for 2014/66 29.11.2016) will be amended into national law:

* **Directive 2014/36/EU** of the European Parliament and the Council of the European Union **on establishing uniform conditions of entry and stay of third-country nationals for the purpose of employment as seasonal workers.** The directive contributes to widening the short-term employment opportunities of third country nationals and extending the maximum duration of short-term work from six to nine months a year. It also allows foreigners temporarily staying in Estonia to be granted a long-term visa of up to one year, and the holders of long-term visa for foreigners extend their stay in Estonia for a short-term employment. Foreigners staying in the country with a short-term visa are granted the right to use job matching services.
* **Directive 2014/66/EU of the European Parliament and of the Council establishes the conditions of entry and residence of third-country nationals in the framework of an intra-corporate transfer from a third country to the EU country. A** new type of residence permit – an intra-corporate transferee permit **– will be established in the Aliens Act and the holder of the** intra-corporate transferee permit from one EU member country is allowed to work in another member country. The permit will be valid for a maximum of three years in the case of managers and specialists and one year for trainee employees.

## Education and skills policy

*Education policy affects innovation in at least three ways: a high level of general and scientific education facilitates acceptance of technological innovation by society at large; innovation systems require well-educated researchers, teachers, extension officers, and producers to develop relevant innovations; it is generally easier for farmers and business operators with higher education and skills to adopt some technological innovations. Continuous skills development (training, re-training) is essential to improve the matching of skills demand, in an evolving agri-food sector, which needs to adopt productivity and environmentally enhancing technologies and practices.*

### Characteristics of the education and training system

1. Estonian educational system is governed by the Education Act, which was adopted in 1992 (RT I, 23.03.2015, 254). The education system is comprised of two subsystems: 1) education devised on the basis of the objectives and levels of education; 2) educational institutions as organisations responsible for implementing the objectives of education.
2. Requirements that are called the standard of education have been set for each level of education and they are presented in national curricula. On the basis of the education levels, education is classified as follows:

* pre-school education, which is given either in the kindergarten or child care institution;
* basic education (first level of education) – the minimum level of compulsory general education prescribed by the national standard of education;
* Secondary education (second level of education): a) General secondary education is a set of requirements established by the national curriculum for basic schools and upper secondary schools; b) Vocational secondary education is a set of requirements established by the vocational education standard and the national curricula for vocations or professions.
* Higher education (third level of education) – since 2002/2003 Estonia has a three-tiered higher educational system, which is in accordance with the EHEA bachelor-master-PhD model. Higher education can be acquired at the professional higher education level, Bachelor’s, Master’s and Doctorate (PhD) levels.
* Continuing education – i.e. general educational and professional knowledge, skills and experience, and the behavioural norms and values complying with the professional requirements, which are necessary for maintaining and expanding existing knowledge, skills, experience and behavioural norms and values.

1. In Estonia education is given by the following institutions (RT I, 23.03.2015, 254):

* Preschool childcare institutions;
* Hobby schools;
* Basic and secondary schools;
* Vocational educational institutions;
* Institutions of professional education;
* Universities;
* Continuing education institutions.

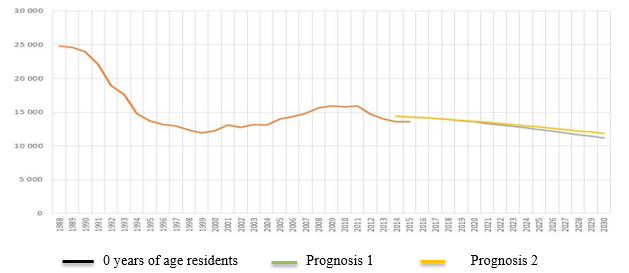
1. The management of the education system is organized by the Parliament, the Government, the Ministry of Education and Research (MER) and the local authorities in accordance with their statutory competences. The MER is responsible for ensuring the quality of the educational institutions. The External Evaluation Department of the MER is responsible for external evaluation. The Higher Education Department coordinates external evaluation in higher education and the Research Policy Department in research. External evaluations are preceded by internal evaluations. The staff, students and external stakeholders (e.g., alumni, employers, in case of general education also the parents) participate in the evaluation. The experts and students involved in the process of external education, and in case of vocational training institutions, assessors and employers, are selected via a public procurement procedure. The results of the external evaluation form a basis for assessing the sustainability of the educational establishment or the curriculum. At gymnasiums the results of the internal evaluation are taken into account in the elaboration of the development plan. (MER, 2016h)
2. An eight-level EstQF was established in 2008, which includes both the general education qualifications and vocational education qualifications. The descriptions of levels of the Qualifications Framework determine general requirements for learning outcomes of the education system and for professional levels of the professional qualifications system. Estonian Qualifications Authority – foundation *Kutsekoda* – is the national coordination point (NCP) that is responsible for the implementation. The EstQF consists of four sub-frameworks, the learning outcomes of each of these have been described in terms of levels. The descriptions of EstQF levels determine the learning outcomes described in the learning outcomes of general education qualifications and competence requirements for professional levels. In 2000, the EU adopted the Lisbon strategy, which aimed at creating the foundations of a genuine Europeanarea of lifelong learning, and developing a lifelong learning system in member states. Since 2011 the EstQF has been linked to the *(European Qualification Framework - EQF)*. (MER, 2016d) The following Table 5.1 presents the results of assigning the EstQF levels to Estonian formal education qualifications, and levelling of some occupational qualifications.

**Table 5.1. Formal education qualifications, occupational groups and qualifications according to the EstQF levels**

|  |  |  |
| --- | --- | --- |
| Formal education qualifications | Level | Occupatonal groups and occupational qualifications |
| Basic education certiﬁcate based on simplified curriculum; | 1 |  |
| Basic education certiﬁcate; VET certificate  level 2 (without basic education requirement) | 2 | Elementary workers (Cleaner assistant...) |
| VET certificate level 3 | 3 | Skilled workers, machine operators, Service and sales workers, Clerical support workers (Logger, Baker, Carpenter, ...) |
| Upper secondary general education certiﬁcate;  VET certificate level 4 (upper secondary VET) | 4 |
| VET certificate level 5 (based on upper  secondary education certiﬁcate) | 5 | Technicians and craft masters, front line managers, clerical workers (Electrician, Construction Site Manager, Accountant, ...) |
| Bachelor's degree, Professional higher education certificate | 6 | Specialists,  supervisors (Energy auditor, Career Counsellor, ...) |
| Master's degree | 7 | Specialists, managers (Diploma Engineer, ...) |
| Doctoral degree | 8 | Senior specialists, top managers (Principal Architect, Chartered Engineer, ...) |

Source: The Estonian Qualifications Authority (2016)

1. In Estonia, governance of the education system is shared between central and local authorities, and schools have a high level of autonomy for resource allocation. The state sets national standards and establishes principles of education funding, supervision and quality assessment. Early childhood education and care is managed by local authorities, and most decisions in lower secondary education are taken at the school level. (OECD, 2016c)
2. Schools in Estonia have a level of autonomy above the OECD average, including the capacity to make decisions on the curriculum and to hire and dismiss teaching staff. Lower secondary teachers are required to have five years of initial teacher training, including a mandatory teaching practicum, and follow continuous professional development. Primary and secondary teachers have below-average class sizes and teaching time. Their salaries are lower than the OECD average, despite a significant increase since 2000. A lower proportion of teachers in Estonia than the TALIS (The OECD Teaching and Learning International Survey) average consider that the teaching profession is valued in society and would choose to work as teachers if they could decide again. Teacher appraisal is used for career advancement and to some extent to determine the need for professional development, but there is currently no appraisal system for school leaders. A system-level assessment of the education system is carried out yearly by the MER. (OECD, 2016c)
3. The demographic forecast for Estonia shows that the population is ageing and the number of births continues to decline (Figure 5.10).

**Figure 5.10. Trends in the number of newborns with projections till 2030**

Source: Statistics Estonia, 2016

1. Largely due to the demographic situation and the forecasts the number of schools has decreased by 11% over the last decade in. The number of students enrolled in full-time general education has dropped by approximately 14% in the past decade (Figure 5.11), and by about 40% in the past 17 years. 2016-2017 will see a slight increase in the number of students entering elementary school, but in 2018 upward trend will be sustained again. At the same time, the number of upper secondary school students and students will continue to decrease. The trends related to the number of students in general education are relatively similar across the different regions and cities (Figure 5.12 and 5.13). The number of primary school students (grades 1-6) has remained the same or fluctuated slightly since 2010, with the exception of the largest county in Estonia - Harju County, where a significant rise in the number of primary students can be detected. The number of secondary school students has gone down in all counties and stabilised in the past few years. (EHIS, 2016)

**Figure 5.11. The number of full-time students and schools in 2006-15**

Source: MER (2016d)

**Figure 5.12. Trends in the numbers of general full-time primary school students by counties in 2010/11-2015/16**

Source: EHIS (2016)

**Figure 5.13. Trends in the numbers of general full-time secondary school students (grades 10-12) by counties in 2010/11-2015/16**

Source: EHIS (2016)

1. Decrease in the number of students is characteristic of all educational levels (Figure 5.12). Until 2010, the number of students participating in vocational education was relatively stable, but since the 2010/2011, the low birth rate of the second half of 1990-s has had a negative impact on this indicator and the trend is going to continue in the coming years. In recent years, the average age of students in vocational education in Estonia has significantly increased. The number of students over 20 years of age in vocational education has grown since they want to acquire vocational or professional skills and thereby increase their competitiveness in the labour market (Figure 5.13). There is no statistics available on the age distribution of students by areas of study and location of the educational establishment. The number of admissions to higher education has decreased in the past years, and this tendency has been in line with the change in the number of full-time secondary school graduates (Figure 5.11). As the number of secondary school graduates in the coming years will continue to decline and the proportion of older people admitted to the first tier of higher education has remained at the same level, it is likely that the number of students is continuing to decline (MER, 2016f).

**Figure 5.12. Number of students in general, vocational and higher education, 2009-14**

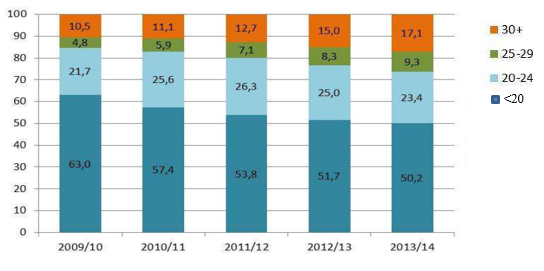
Source: MER (2016f)

1. While the general trend in the number of students enrolled in vocational training in Estonia has been declining, the number of students engaged in such fields of study as agriculture and arts and humanities has been going up in the past five years (Figure 5.15).

**Figure 5.15 Student numbers in vocational education by fields of study, 2003/04 -13/14**

Source: EHIS (2016)

**Figure 5.13. The distribution of students in vocational education in 2008/09-2012/13 by age.**



Source: MER (2014c)

1. Over the past five years the number of students by the field of study dropped by nearly a quarter. However, the proportion of students in each field has remained practically the same. A small fall can be detected in such fields as social sciences, business and law, and services (2% and 1%, respectively) and a small increase in sciences and technology, and sealth and wellness (also 2% and 1%, respectively). The share of students specialising in agriculture has remained unchanged (2%). (Figure 5.17). Similarly to the changes in the age structure of the students in vocational education, the number of adult students (over the age of 30) enrolling at the university has also increased, with the exception of education, and health and wellness.

**Figure 5.17 Number of students by fields of study in 2003-16**

Source: EHIS (2016)

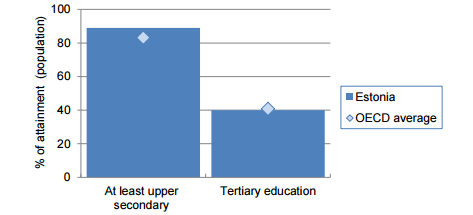
1. Despite the overall decrease in the number of students, the number of adult learners (30 and older) in higher education has remained relatively stable over the years. At the same time, in vocational education the number of adult learners has been on the rise, whereas in higher education the corresponding figure has suffered a small decline since the 2012/2013 (Figure 5.14).

**Figure 5.14. Adult learners in Estonia, 2009-15**

Source: MER (2016f)

1. Secondary education attainment in Estonia is above the OECD average, while tertiary attainment is at the OECD average: 89% of the 25-34-year-olds have attained at least upper secondary education (compared to the OECD average of 83%), and 40% have attained tertiary education (compared to the OECD average of 41%) (Figure 5.15) (OECD, 2016c).

**Figure 5.15. Upper secondary and tertiary attainment for 25-34 year-olds, 2014**



*Source:* OECD (2015), Education at a Glance 2015: OECD Indicators, OECD Publishing, Paris, http://dx.doi.org/10.1787/eag-2015-en.

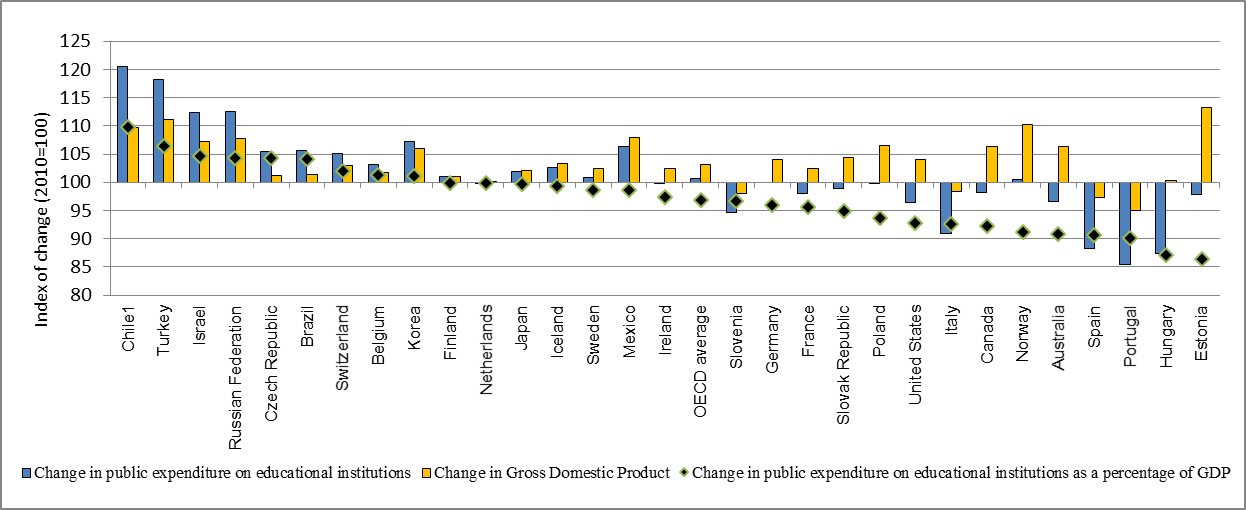
1. The share of 25-64-year-old students (%) attaining formal education or participating in trainings is higher in Estonia as compared to the EU average, especially at the expense of adults in vocational education. There is a big proportion of people in Estonia who have not finished their general education and who are acquiring basic or secondary education in different flexible forms of non-stationary programmes, where they can study single specific subjects or take the final exams as an external student. However, trends in the EU and Estonia have been diametrically opposed – in the EU the proportion of adults participating in formal education or training in 2012-2014 increased, whereas in Estonia the figure dropped. (Figure 5.16).

**Figure 5.16. The number of 25-64-year-olds (%) enrolled in formal education or training**

Source: Ministry of Education (2016f)

1. Adults without basic or secondary education are the most vulnerable group in the labour market in Estonia. The unemployment rate is the highest among adults without secondary education (13.3% of the 15-74-year-olds in 2015) and their wages are also the lowest. On the gender basis there are about twice as many men (in 2015 19%) without secondary education than women (10%), whereas more women seek to continue their studies, particularly in general secondary education, where approximately 60% of the students over 20 are women. By age groups, there are more people without secondary education among the 25-39-year- olds (16-18%). The number of such people among the 40-54-year-olds is two times smaller (only 7-9%) and in the age group 55+ again higher than among 10 years younger population (the divergence can be explained by compulsory secondary education in 1970/80-ies). (MER, 2016e). Low level of education and lack of professional skills are the main obstacles to finding a job, both in urban and rural areas. In 2015, only a third of the people with basic education had a job, whereas the employment rate for people with higher education was 78% and for vocational education 67-72%. (MRA, 2016j). The employment rate in rural areas has grown year on year, from 53.7% in 2009 to 65.3% in 2015, but the problem lies in the lower level of education of the rural working age population, which considerably limits their competitiveness in the labour market. The shares of population with secondary and/or vocational education or second-tier education are practically equal in rural and urban settlements, whereas the proportion with only primary or basic education is higher in rural areas. (EMU, 2011)
2. Education in Estonia is mainly financed by the government and 93% of the expenditure on basic, secondary and higher education is covered from the state funds (OECD average 83%). Private funding (by private bodies and households) in higher education in 2012 amounted to 22%, which is more than in the basic and secondary education (0.9%). The proportion of private funding of higher education was similar to the average in 21 EU countries, but lower than that in OECD countries (30%). Since 2013/2014, studying full-time on programmes where the language of tuition is Estonian, is free of charge both in state-owned institutions of higher education as well as in public universities (OECD, 2015d).
3. The change in the public expenditure on educational institutions as a percentage of GDP has recorded the greatest decline among the OECD countries. Between 2005-2012 the number of students in basic and secondary education and post-secondary vocational education decreased by about 20%, which is one of the biggest slumps in the OECD countries, whereas the total expenditure on education increased by 5% and spending per student increased by 31% (OECD average 21%). At the same time, however, the public expenditure on educational institutions as a percentage of GDP decreased the most (Figure 5.17) (OECD, 2015d).

**Figure 5.17. Public expenditure on education and index of change in public expenditure on educational institutions and in GDP (2010-12)**



Index of change between 2010 and 2012 in expenditure on education institutions as a percentage of GDP, primary to tertiary levels of education (2010=100, 2012 constant prices)

*Note:* Countries are ranked in descending order on the basis of expenditure on educational institutions as a percentage of GDP.

*Source: OECD Education at a Glance 2015.* Chart B2.4. [*www.oecd.org/education/education-at-a-glance-19991487.htm*](http://www.oecd.org/education/education-at-a-glance-19991487.htm)

1. The fields of science and engineering have progressed the most in Estonian higher education, presenting, unlike for the OECD average, an equal interest to both male and female students. In Estonia, on average every third and in the OECD countries every fifth graduate obtained their Master's degrees in science or engineering, manufacturing and construction, and more than a half of doctoral graduates acquired their degree in science and engineering (Figure 5.18).

**Figure 5.18. Percentage of students (all students or international students) who graduate from sciences and engineering at doctoral level (2013)**

Source: OECD Education at a Glance 2015. Chart A3.4.OECD (www.oecd.org/edu/eag.htm).

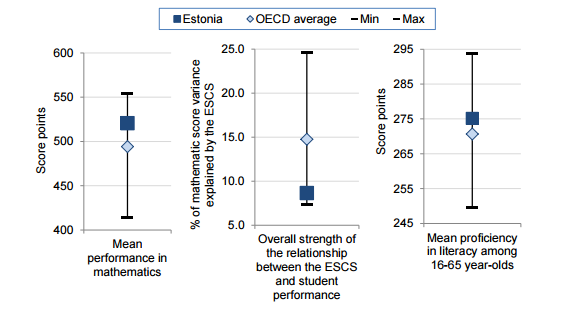
1. Estonia has been historically characterized by a high attainment of higher education. In 2014, 38% of people aged 25-64 had higher education, whereas the OECD average was 32%. Estonia has a long traditions of higher education and the proportion of older generation with tertiary education is relatively high: 36% of 55-64-year-olds have received higher education. However, the OECD average is 25%. (Figure 5.19)

**Figure 5.19. Proportion of the 25-35- and 55-64-year-old population with tertiary education, %**

Source: OECD Education at a Glance 2015. [www.oecd.org/education/education-at-a-glance-19991487.htm](http://www.oecd.org/education/education-at-a-glance-19991487.htm)

1. Estonian educational system has participated in survey conducted in the framework of the PISA (program for international student assessment) four times (in 2006, 2009, 2012 and 2015) and in 2011-2012 Estonia participated in the PIAAC (Programme for the International Assessment of Adult Competencies) survey for the first time. The results of the study showed that Estonia was among the top performers in reading, mathematics and science in PISA 2012. Between 2009 and 2012, Estonia increased its share of top performers and simultaneously reduced its share of low performers in science. The impact of socio-economic status on student performance (8.6%) is below the OECD average (14.8%). Estonian adults (16-65 year-olds) performed above the OECD average in literacy and numeracy in the OECD Survey of Adult Skills (PIAAC). (Figure 5.20). (OECD, 2016c)

**Figure 5.20. Performance of 15-year-olds in mathematics, relationship between student performance and economic, social and cultural status (ESCS) (PISA 2012) and performance of adults in literacy (PIAAC)**



*Note:* “Min”/”Max” refer to the OECD countries with the lowest/highest values.

*Sources*: PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading, and Science, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264208780-en; OECD (2013), OECD Skills Outlook 2013: First Results from the Survey of Adult Skills, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264204256-en>.

1. The results of the PISA survey show that the basic level schoolchildren are also among the best performers as compared to other countries in the world and in Europe (Table 5.2).

**Table 5.2. Estonian results of the PISA survey 2006, 2009 and 2012**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Area | 2006 | | 2009 | | 2012 | |
| World | Europe | World | Europe | World | Europe |
| Reading | 13 | 8 | 13 | 5 | 11 | 4 |
| Mathematics | 14 | 6 | 17 | 7 | 11 | 4 |
| Natural sciences | 5 | 2 | 9 | 2 | 6 | 2 |

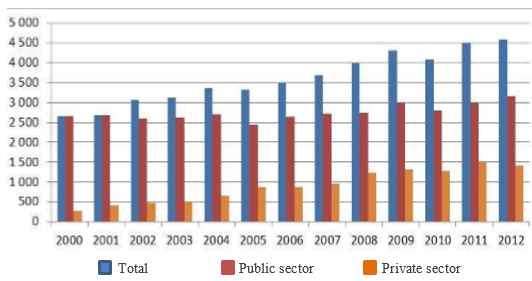
*Source:* MER 2013. PISA 2012 Summary of the PISA results <http://www.innove.ee/UserFiles/%C3%9Cldharidus/PISA%202012/PISA_2012_uuringu_tulemuste_kokkuvote.pdf>

1. Estonian schools differ in their structure of student body, in the learning strategies the students use, as well as in their attitudes to learning. No significant relationship between the location of the school, and the student’s average performance has not been identified. An analysis based on the data from the PIAAC and the Estonian Education Information System (EHIS) shows that the differences in the results of national examinations and the length of educational pathways depend, first and foremost, on gender and the language spoken at home, as well as on the mother's level of education.
2. Over the past 30-40 years the differences in the length of educational pathways between women and men, and between Estonian and any other language spoken at home have increased in favour of women and the Estonian language. In either case, the difference between the two groups is a year, or a bit more. Besides gender and the language spoken at home, the length of the educational pathway is affected by the general background, the parents' education and, in post-secondary studies, also the results of national examinations. Among other factors, the latter depend on both the location of the basic school and the language of instruction. (MER, 2016e).
3. PIAAC 2012 study results show that Estonian adults perform above average levels in numeracy and functional literacy, surpassing the average result of the surveyed countries. Compared to their peers on the tertiary level of other participating countries, functional literacy in Estonia has been at the average. The same is true for all separate levels of higher education study (applied higher education, Bachelor's, Master's and PhD levels). This allows to conclude that the quality of higher education is internationally competitive.
4. The numeracy and functional literacy of Estonian young adults with basic and secondary education (16-29) is also above the average. The problem-solving of the young adults are on the average. A clear link between age and skills can be identified. The relationship is non-linear and largely negative: without taking into account other factors, the skills among older people are significantly lower, where the difference in problem solving skills between the 60-65- and 20-24-year-olds is 48 points. Formal education plays the biggest role in acquiring specific skills, having the strongest effect on numeracy. Problem-solving skills in technology-rich environments are the least affected by formal education. (MER, 2015b).
5. PIACC results show that often computer literacy is required in some occupations in Estonia, but the computer skills of the employees do not meet the contemporary requirements and are limited to specific activities only. In this part the personnel at Estonian educational institutions stand out. Their problem-solving skills in technology-rich environments are almost the lowest, while the frequency of computer use at work is still among the average. The survey also revealed that a significant number of young people (up to 24 years of age), who have good computer and problem-solving skills and use computers in everyday life are currently holding such jobs where computer skills are not needed (mainly in hotel and catering services). (Pruulmann-Vengerfeldt et al., 2015)
6. The most important conclusion of the PIAAC 2012 analysis is that the content of the work and workplace characteristics affect participation in lifelong learning more than the characteristics of an individual (including their education and level of skills). Therefore, the demand side of the training is of utmost importance because new skills and/or a higher level of education do not have an independent value without the possibility to apply them in practice. As to the skills employed at work Estonia falls below the international average. In Estonia, people have more skills than required on the labour market. More than a third of the employed are overeducated. Estonia ranks the first with its proportion of the overeducated among the PIAAC participating countries. All those whose highest level of education attained exceeds the level that would be required for their employment are considered overeducated and those whose highest educational attainment is below the level of education that would require them to obtain work are underemployed. According to this definition, it turned out that 36.9% of the sample employed were overeducated and 12.6% underemployed. The likelihood of overeducation is greater among the elderly and those with higher education. As to the field of activity concerning overeducation agriculture, hunting, forestry and fishing, manufacturing, construction, accommodation and catering are affected the most, whereas those in the fields of education, professional education, research and technological activities, public administration and defence, health- and social care activities are less affected. Underemployment is the smallest among the graduates of agriculture, engineering, manufacturing and construction, and services, as well as graduates of higher education institutions. (MER, 2015b).
7. A survey carried out among the alumni in Estonia in 2015 showed that only 50% of respondents felt that their current position required higher education, 11% thought that their job required professional education, another 11% thought secondary education was sufficient and 15% of the respondents stated that the level of education was not important in their profession. This can partly be attributed to not being able to find a professional job. (Laan et al., 2015)
8. Since 1989, considerable changes can be identified in the structure of employment: the share of skill-intensive positions has increased from 35% to 42.7% in 2014, and the trend towards more complex positions continues. However, Estonian entrepreneurs and foreign investors consider the shortage of adequately trained personnel a key challenge in the local economic development.
9. In Estonia the skills of the graduates in the field of teacher training, engineering, manufacturing and construction present the biggest problems. The skills of the graduates in natural science and engineering, as well as in the humanities and social sciences are at a higher level. In comparison with other EU countries, the problem-solving skills of Estonians employed in manufacturing and processing industry are by far the weakest, and as to using computer at their workplace the second weakest. In Estonia both the level of computer skills and the frequency of computer use are comparatively low, the exception being the agricultural sector, where skilled workers use computers at work and in quite a number of different ways. For example, 37% of them use the computer for work-related purposes, whereas the number of such users in Finland is 24%, in the Czech Republic 23% and for other countries this figure is even smaller. In comparison of the six countries Estonia ranks the first in the ICT use in this sector. (MER, 2015b)

### Place of science in formal education

1. As elsewhere in the world the popularization of science in Estonia in the general education system is performed through studying science in informal environment (see also Chapter 7). The survey carried out by the Centre for Policy Studies Praxis in 2013 “Study on various activities for popularizing science and technology” revealed that the knowledge and skills, as well as the educational tools do not sufficiently support the implementation of approach to teaching approved the national curricula in 2010 (promoting the personal and social development of each learner, supporting the development of learning skills, creativity and entrepreneurial spirit, which is one of the strategic aims of the Lifelong learning strategy 2020), and that the present formal education system does not encourage students’curiosity, creativity and innovation, and linking knowledge and life, show the necessity of science and technology in social development, etc. Experts estimate that science popularization activities are started too late, when most of the students have made their (professional) choices for the future already. The lack of cooperation between the people involved in the popularisation of science and relying on their personal experience only may also cause a problem. Estonia lacks a system for the fruitful introduction of science into formal education. (Kirss et al., 2013)
2. In higher education, science has been integrated into the curriculum, including the learning outcomes, which have been set out in the Standard of Higher Education. (RT I, 23.08.2016, 6)
3. In increasing the number of doctoral graduates is a real challenge for research in Estonia. In 2010-15, the number of doctoral graduates has fluctuated between 175 and 250, whereas the target to be reached by 2020 laid down in the Estonian Lifelong Learning Strategy is 300 graduates a year. The “Study of effectiveness of doctoralprogrammes in Estonia” (Eamets et al., 2014), points out that due to the demographic trends in Estonia and a decrease in the number of externally financed doctoral study places after the introduction of the requirement to pay support to all doctoral students, the number of applicants to doctoral studies may decrease in the coming 5-6 years. The analysis also revealed that the prospective career path is not an essential motivator for the PhD candidates. This is an indication of the fact that, on the one hand the wages in the academic sector are not competitive on the labour market any more, and, on the other hand, the employers in the private sector do not attach any value to the doctoral degree. There are not enough large companies in Estonia that have the need and the opportunity to recruit PhD students and specialists with a PhD. Only 1% of the adult respondents with higher education participating in the PIAAC study said that they would have required a doctoral degree to get the job, which is two times less than the total of the 24 PIAAC participant countries and, for example, five times less than in Finland. Both the national and international studies, as well as the survey conducted among the doctoral students, confirm that the good relations of the doctoral student with the university, participation in a research group and the link between the activities and the theme of the dissertation form a prerequisite for the successful PhD completion. Being involved in their main activities mostly outside the academic sector was considered the main obstacle to completing the thesis, which means that the present doctoral allowances do not guarantee economic livelihoods and do not allow the students to commit to their doctoral work.
4. According to the Innovation Union Scoreboard 2013 the number of new doctorate holders per 1 000 population in the age group of 25-34 in the EU is 1.5. The corresponding figure for Estonia is below the EU average (0.9). (MER, 2014c)
5. Pursuant to the Estonian RDI strategy “Knowledge-based Estonia 2007-2013” and the use of human resources development program, the MER financed a wide range of measures and actions supporting the research community and the next generation of scientists in the fields of natural and exact sciences and technology (see also Chapter 7). The main desired results of the science popularisation activities are to generate interest towards research and technology, improve the attractiveness of research and engineering career, and ensure the spread of scientific world-view in the society.
6. The annual growth in the number of scientists and engineers employed in R&D full-time in Estonia is 4.6% per year on average (over 2000-12). Compared to 2000, the growth has been fastest in the business sector, where the number of full-time researchers has increased more than five times, accounting for 34% of the total number of researchers in 2012 (Figure 5.21). (MER, 2014c)

**Figure 5.21. Increase in the number of full-time researchers in Estonia in 2000-12**



Source: MER (2014c)

### Programmes that promote life-long skills development and re-training; performance of the programmes

1. On the European level the strategic objectives of the cooperation in education and training have been laid down in the Education and Training 2010 work programme. The work programme has defined the principles and methods for moving towards achieving its objectives. The strategic objectives of the programme are:

* Making lifelong learning and student mobility a reality;
* Raising the efficiency and quality of education and training;
* Implementing the principle of equal opportunities, social cohesion and active citizenship;
* Facilitating innovation and creativity, including entrepreneurship at all levels of education and training.

1. Indicators and targets have been defined to achieve the objectives by 2020, including:

* At least 15% of the adult population participate in lifelong learning;
* The share of low-achieving 15-year- olds is less than 15%;
* The share of tertiary educated people aged 30-34 accounts for at least 40%;
* The early drop-out rate from the school is less than 10%;
* At least 95% of the 4-7-year-olds (until the start of compulsory primary school) participate in early childhood education.

1. Lifelong learning involves formal education (kindergarten, basic school, gymnasium, vocational school, higher educational institution), as well as training and retraining, non-formal and informal learning in all its diversity. Estonian Lifelong Learning Strategy 2014-20 is the key strategy guiding the most important developments in the educational sector. The strategy forms a basis for the decisions on educational funding in the strategy period, and for the development of programmes that support the achievement of necessary changes.
2. To implement the strategy, several sub-programmes have been devised for 2016-19, including:

* General education programme;
* Vocational education programme;
* Higher education programme;
* Adult education programme;
* Competent and motivated teachers and school leadership education programme
* Digital turn programme;
* Study and career counselling programme
* Labour market and education cooperation programme
* School network programme

1. The planning, budgeting, implementation and reporting activities are performed via the sub-programmes. The programmes approved in 2016 are valid for the period 2016-19. The programmes are reviewed at the end of each calendar year pursuant to the State Budget Act, the (MER, 2014b).
2. Each program has its objective and as a rule objectives of the programs are intertwined. To achieve the objectives, specific activities have been planned and respective indicators and targets set (Table 5.3).

**Table 5.3. Lifelong learning strategy and its implementation plan for the implementation of the programs drawn up for the period 2016-19**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Pro-gramme** | **Goal** | **Indicators** | **Baseline**  2012-14 | **Target**  2018-20 |
| **General education programme** | Grant all students equal access to high-quality general education and readiness for making further choices regarding education | Percentage share of students remaining below PISA level 2, (%)  Basic skills in reading  Basic skills in mathematics  Basic skills in science | 9.1  10.5  5.0 | 7.5  8.0  5.0 |
| Percentage share of students reaching PISA levels 5 and 6, (%)  Basic skills in reading  Basic skills in mathematics  Basic skills in science | 8.4  14.6  12.8 | 10  16  14.4 |
| Percentage of non-working young people (aged 18-24), whose level of education is low (%) | 11.4 | <10.0 |
| Satisfaction of different stakeholders with the study environment and management of studies | - | increasing |
| Percentage of students with special educational needs (SEN1) (additional support measures and conditions) in mainstream school (%) | 93 | 100 |
| Percentage of students with serious special educational needs (SEN2) in mainstream school (%) | 28 | 33 |
| **Vocational Education programme** | Create the Estonian population opportunities for vocational studies that are of a good quality, flexible and diverse in their selection and meet the needs of the labour market. | Share of non-working young people (aged 18-24), whose level of education is low (%) | 10.5 | <10 |
| Share of basic school leavers who continue their education in full-time vocational studies (%) | 28.6 | 32 |
| Percentage distribution of upper-secondary students by orientation – general vs vocational (%) | 67:33 | 62:38 |
| Early leavers from vocational education (in the first year of vocational secondary education (%) | 25.8 | 22 |
| Employment rate of recent graduates (aged 20-34) one to three years after leaving education (%) | 73.9 | 80 |
| Percentage of adults aged 25−64 in life-long learning | 12.9 | 18 |
| Percentage share of adults (aged 25−64) without vocational or professional education (%) | 30.3 | 26 |
| **Higher Education Programme** | Grant every motivated and competent candidate equal access to high quality and flexible higher education that offers diverse selection and meets the development needs of the labour market | Tertiary education attainment in age group 30-34 (%) | 31.9 | 40 |
| Employment rate of recent graduates of tertiary education (aged 20-34) one to three years after leaving education (%) | 84.3 | 88 |
| Number of curricula at the tertiary level | 782 | 735 |
| Early leavers from tertiary education (at the beginning of their studies) (%) | 22.5 | 15 |
| Share of tertiary graduates in Science and technology, Engineering, manufacturing and building as a percentage of all tertiary graduates (%) | 22 | 25 |
| Number of IT graduates per year | 565 | increasing |
| Short-term student mobility (%) | 3.4 | 10 |
| Percentage of foreign students enrolled at Estonian higher education institutions (%) | 3 | > 10 |
| **Adult Education programme** | Motivate adults to study and create high-quality and flexible opportunities for life-long learning that meet the needs of the labour market | Percentage share of adults (aged 25−64) without vocational or professional education (%) | 29.6 | 25 |
| Share percentage of adults participating in life-long learning programmes (%) | 12.5 | 20 |
| Early leavers from part-time general education as a percentage of all students (%) | 35 | 30 |
| Percentage of 25+ students in vocational education as a percentage of all students (%) | 26.3 | 33 |
| Share percentage of adults aged 25-64 with low level of education participating in life-long learning (%) | 4.6 | 6.5 |
| **Digital focus programme** | Apply digital technology in learning and teaching, taking into account the needs and abilities of the students | Percentage of 8th-year students who study at digitally supportive schools (%) | 33 | 100 |
| Percentage of 8th-year students who study at schools with virtual learning environment from total number of 8th students (%) | 54 | 100 |
| Percentage of basic school graduates whose ICT basic skills are assessed and certified (%) | . | 100 |
| Percentage share of students (at different levels) who use computers, digital and mobile personal devices for studies every school day (%) | . | 100 |
| **Competent and motivated teachers and school leadership** | Harmonize the evaluation and development of teachers and school leaders with the contemporary approach to learning and increase the popularity of the teaching profession | Percentage share of students remaining below PISA level 2, (%)  Basic skills in reading  Basic skills in mathematics  Basic skills in science | 9.1  10.5  5.0 | 7.5  8.0  5.0 |
| Drop-out rate from the basic school in the tertiary level (%). | 0.60 | <1 |
| Drop-out rate (%)  From the upper secondary school/from the first year of upper secondary school  From the vocational education establishment | 1.1  25.8 | <0.8  <20 |
| Share of teachers and leaders of educational institutions who were awarded a qualification after participation in the training | 95 % | 97% |
| Percentage of school leaders, who introduced measures to support teacher cooperation to work out new teaching methodology (%) | 58 | 75 |
| Percentage share of students, who claim that they are happy at school, (%) | 66 | 72 |
| Percentage share of teachers aged 30 or younger in general education, (%) | 10.3 | >12.5 |
| Competition for study places in teacher education | - | increasing |
| Gender distribution in general educational establishments (men/women) (%) | 85.7:14.3 | 75:25 |
| Percentage share of teachers, who find that the teacher’s job is valued in the society (%) | 13.7 | 20 |
| **Study and career counselling programme** | Grant the accessibility of support services equally across the country; support young people with high-quality counselling so that they could get the education within their powers that addresses the needs of the labour market and prepares them for labour market participation | Percentage share of non-working young people with low level of education, aged 18-24 | 10.5% | ‹ 9% |
| Share of tertiary basic school students, who have received career information and/or individual counselling and who, as of November of the year after leaving basic school, continue their studies on the next level | 93% | 96% |
| Number of children, students and young people who passed study and career counselling | 0 | 174 930 |
| Number of tertiary basic school students, who received individual career counselling | 0 | 75 680 |
| Number of secondary school and vocational school students, who received individual career counselling | 0 | 50 800 |
| Number of young early leavers from education, (aged 18-24, with basic or lower level education), who received career counselling | 0 | 950 |
| Number of children and students, who passed study counselling | 0 | 47 500 |
| Number of parents, educational staff and young people engaged in higher education, who received counselling | 0 | 30 00 |
| **Labour market and education cooperation programme (OSKA)** | Bring the study opportunities into concordance with the needs of the labour market. Increase the number of workforce with professional qualifications both among younger and older people. | Number of OSKA Sectorial Councils | 0 | 20+1 |
| Percentage of educational establishments that have included the module of entrepreneurship in their curricula on all tiers (%) | 0 | 90 |
| Number of evaluations of study programme groups carried out at vocational education establishments and applied higher educational establishments | 0 | 270 |
| Student awareness of vocational training opportunities, percentage of respondents (%). Students, who are well aware of the study opportunities in vocational education  From basic school  From upper secondary school | 61%  57% | 70%  65% |
| Percentage of educational establishments participating in practical training programme of the total number of all respective educational institutions (%) | 0 | 80 |
| Number of students participating in apprenticeship programme (‘Õpipoisiõpe’) | 580 | 8000 |
| Number of enterprises participating in apprenticeship programme (‘Õpipoisiõpe’) | - | 350 |
| Number of participants in language training | 0 | 3000 |
| **School network programme** | Adjust the school network to the demographic changes and guarantee equal access to high quality education in Estonia | Number of public upper secondary schools | 5 | 24 |
| Number of schools with upper secondary level | 202 | ~100 |
| Space per student (m2) at schools receiving support for the reorganisation of the general education network | 14.8 | 11.5 |
| Number of modernised public and municipal vocational education establishments | 17 | 24 |
| Modernised space | 0 | 115000 |
| Number of schools for students with special educational needs (SEN) | 36 | 26 |
| Percentage of students with special educational needs (serious disability) engaged in mainstream schools (%) | 28 | 35 |

Source: MER (2014b)

1. The structure and contents of the analysis proceed from the sectoral strategies of the MER and the long-term goals set out in them. The summary is divided in five parts: (1) areas where developments are very positive; (2) areas in which the development has been stable or good; (3) areas where progress does not meet expectations and where current activities need to be revised; (4) indicators we do not measure; (5) issues that need further analysis or research.
2. Areas where development has been very positive and we are close to achieving the objectives set for 2020 (MER, 2015c):

* The share of 30-34 year olds with higher education has grown, exceeding the 40% of this age group. This is the goal of both Estonia 2020 and Europe 2020.
* The share of graduates from higher educational institutions in natural and exact sciences, technology, engineering, manufacturing and construction in 2013-14 has been over 24%, which is close to the 2020 target of 25%.
* The unemployment rate among young people, aged 15-24 years, has decreased over two times (from 33% to 15%) in the past five years (2009-14), which is mainly attributable to an improved labour market situation, but is still a very positive development in the EU context. The target for 2020 is 10%. In 2014, the difference between the employment rate of young adults, aged 15-26, in urban and rural settlement differed by 7.8% (in urban settlements 50.3% and in rural settlements 42.3%), and has shown a slow but steady decline over the past 10 years (11.5% in 2005; 10.6% in 2010; 7.8% in 2014). (Eesti Noorsootöö Keskus. 2016) In 2010-13 the employment rate was the lowest in rural population with basic education (23.2%, 26.2% and 28.2% and 32%, respectively), followed by those with secondary education (58.4%, 63%, 64.9% and 64.9%). Rural population with tertiary education was in the most favourable situation (75.4%, 77.6%, 77.7% and 77.2%). (MRA, 2014c)
* The share of adults (aged 25-64) with no professional or vocational training was less than 30% in 2014, which is one of the goals of Estonia 2020.
* The proportion of 25 year-old and older learners has increased in vocational education.
* The share of youth with a lower level of education and not involved in education (18-24-year-olds) dropped below 10% for the first time in 2013, however, by 2014 it was back to 11.6%. The target of the lifelong learning strategy is to decrease this figure to under 9%. The percentage of people with a lower level of education among the working-age population in rural settlements was higher than that in towns (e.g., 13.7% of the working age population in 2011 and 13.2% in 2013) (MRA, 2014c). The education level of working age population in Estonia differs also by regions (e.g., 7.9% in North-Estonia and 16% in Central Estonia (in 2011) (MRA, 2014d). Corresponding data for young adults (18-24) in rural and urban settlements could not be retrieved.

1. The implementation of activities planned within the education (MER, 2015c):

* In 2015, a total of 56 accreditations were carried out in 13 study programme groups.
* For the purpose of raising the reputation of vocational education, a network of communication specialists in vocational education has been launched, that offers training. A collection of success stories and study opportunities in vocational education “Help for decision-making. Vocational Training Opportunities in 2016/2017” has been published. In order to work out a practical training system in vocational education, a network of traineeship coordinators has been set up. Several network meetings and information days have been organised.
* A number of new curricula that could not have been opened at this level have been launched. For example, it is, at present possible to acquire vocational secondary education in the fields of dairy, meat, fish, vegetables and beverages technology. Basic education grants access to food processing studies, which last for 3-4 years. Students are admitted to specific training in food technology on the basis of secondary education and the last for 2-2.5 years. The qualifications can be acquired in two vocational education centres – the Olustvere School of Service and Rural Economics (www.olustvere.edu.ee) and the Tartu Vocational Education Centre (www.khk.ee).
* The number of interruption cases or early leaving of studies has generally declined, especially in vocational secondary education. The employment indicator of vocational school graduates is on the rise as well.
* In recent years, the number of dropout cases in full-time general education has dropped and stabilized at a relatively low level, at 0.5-0.6% in the third level of basic school and at 0.9-1.1% in the first year of secondary school. One of the expected results of the general education program is a decline in the proportion of non-studying young people with a low level of education.
* There are advisory panels offering career guidance in all counties and a nationwide vocational counselling and placement centre.
* The number of young people registered as unemployed in the course of 12 months following graduation has dropped whereas the number of those who earned income, earned income higher than median income or return from business activities.
* OSKA programme has been launched. OSKA analyses the needs for labour and skills necessary for the economic development of Estonia and the results and forecasts feed the qualification and career guidance systems, curriculum development at educational institutions, and provide input to different agencies and authorities. The economic sectors to be analysed are defined. The analysis of agriculture and the food industry sector will be performed in 2017, whereas that of forestry and timber industry in 2016. (OSKA, 2016)

### Availability of agricultural education; it’s adaptation to labour market needs; job opportunities for graduates in the agricultural and related sectors

1. Agricultural education is available in Estonia, both through higher and vocational education programmes. In 2015/2016 there were in a total 24 universities (including six public universities, eight state and seven private professional higher education institutions, one private university, and two vocational education establishments), 39 vocational training institutions (including 29 state vocational institutions, seven private and three municipal vocational education institutions) and six applied science universities offering professional training (including one private and five public universities of applied sciences). (MER, 2016g) Four higher educational institutions and 14 vocational education establishments teach agricultural and food processing. There is only one higher educational institution specialising directly on agriculture (Estonian University of Life Sciences (EMU)) and two vocational education institutions (Järvamaa Vocational Training Centre and the Olustvere School of Service and Rural Economics).
2. The Estonian University Life Sciences is specialised in agricultural higher education and research. The University promotes the six focal areas – agriculture, environment, forestry, food and health, technology and engineering and rural economy. The university plays a key role in providing qualified workforce the necessary competencies in the use of sustainable technologies and improves attitudes towards more sustainable professional work that is less harmful to the environment. (EMU, 2016b)
3. In 2016 there were 3337 students enrolled at the EMU, 1577 of them on the Bachelor’s level, 121 on the applied higher education level, 604 on the integrated level (programme combining BSc and MSc studies), 819 on the Master’s level and 216 on the PhD level of study 216 (Figure 5.24). In recent years, a downward trend in the number of students can be detected that can be associated with a decrease in the total number of students. The change in the number of students has differed across the fields of study at EMÜ. The number of students studying biosciences, environmental sciences and veterinary medicine has remained comparatively stable or even grown a little. The largest fall in student numbers can be observed in the agriculture, forestry and fishery, and engineering, manufacturing and technology (Figure 5.25).

**Figure 5.24. Number of students at the EMU in 2013-16 (as of 02.06.2016)**

Sources: EMU (2016d)

1. In addition it is possible to study agriculture, fisheries, forestry, life sciences, manufacturing and processing, and environmental sciences also at the University of Tartu, Tallinn University and Tallinn Technical University (Table 5.4), on vocational education level, however, in 14 vocational education institutions, two of which are specialized directly in agriculture and most of the others in teaching food processing (Table 5.5).

**Figure 5.25. Number of students at the EMU in 2013-16 (as of 15.11.2016)**

Sources: EMU (2016d)

**Table 5.4. Study programme groups related to agriculture, forestry, fisheries, manufacturing and processing, veterinary medicine, environmental protection and life sciences (as of 19.05.2016) at Estonian higher educational institutions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| University | Estonian University of Life Sciences | University of Tartu | Tallinn Technical University | Tallinn University |
| Study programme group |
| Horticulture | **x** |  |  |  |
| Biology and biochemistry | **x** | **x** | **x** | **x** |
| Fisheries | **x** |  |  |  |
| Environmental protection | **x** |  |  |  |
| Methods for environmental  protection | **x** | **x** | **x** | **x** |
| Environmental sciences | **x** | **x** |  |  |
| Natural environment and unspoilt nature | **x** |  |  |  |
| Forestry | **x** |  |  |  |
| Agriculture, forestry and fisheries (general) | **x** |  |  |  |
| Farming and animal sciences | **x** |  |  |  |
| Food production and processing | **x** |  | **x** |  |
| Veterinary | **x** |  |  |  |
| Business and administration\* | **x** |  |  |  |
| Accounting and taxation\* | **x** | **x** | **x** | **x** |

\*Curricula in agricultural economics and rural entrepreneurship are taught at the EMÜ only.

Source: EHIS 2016. Curricula

1. In the study programme groups analysed (social sciences, business and administration, law, natural and exact sciences, engineering, manufacturing and construction, agriculture, forestry and fisheries, and service) changes in student numbers over the past few years have followed the same trends as in EMÜ (See also Figure 5.25). The downtrend has been the steepest in the study programme group ‘business and administration’, where EMÜ has only one curriculum – Agricultural Economics and Rural Entrepreneurship. The number of students enrolled in the curricula in veterinary medicine and engineering, manufacturing and technology has remained relatively stable in recent years (Figure 5.26)

**Figure 5.26 Number of students in higher education by fields of study in 2012-2016**

\*Curricula in agricultural economics and rural entrepreneurship are taught at the EMÜ only.

*Source*: EHIS 2016. Number of students by fields of study

**Table 5.5. Study programme groups related to agriculture, veterinary, environmental protection, manufacturing and processing at vocational education institutions (as of 19.05.2016)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Study programme group | | | | | | |
| Vocational education institution | Agri-culture | Fishery | Veterinary medicine | Forestry | Horti-culture | Environmental protection | Food industry |
| Järvamaa Vocational Training Centre | **x** | **x** | **x** |  |  |  |  |
| Olustvere School of Service and Rural Economics | **x** |  |  |  |  |  | **x** |
| Räpina School of Horticukture |  |  |  |  | **x** | **x** |  |
| Luua Forestry School |  |  |  | **x** | **x** |  |  |
| Rakvere Vocational School |  |  |  |  |  |  | **x** |
| Hiiumaa Vocational School |  |  |  | **x** | **x** |  |  |
| Kuressaare Vocational School |  |  |  |  |  |  | **x** |
| Tallinna Construction School |  |  |  |  | **x** |  |  |
| Pärnumaa Vocational Education Centre |  |  |  | **x** |  |  | **x** |
| Tallinn School of Service |  |  |  |  |  |  | **x** |
| Tartu Vocational Education Centre |  |  |  |  |  |  | **x** |
| Narva Vocational Training Centre |  |  |  |  |  |  | **x** |
| Vana-Vigala Technical and Service School |  |  |  |  |  |  | **x** |
| Ida-Virumaa Vocational Education Centre |  |  |  |  |  |  | **x** |

*Source*: EHIS 2016. Curricula

1. In vocational education, the number of students in such curricula groups as environment, agriculture, veterinary medicine and manufacturing and processing has remained relatively stable. An increase can be observed in the field of agriculture, forestry and fishery, whereas the number of students in manufacturing and processing suffered a marginal decline. In 2012, a new specialty – veterinary assistant – was opened in professional education, which has positively affected the total number of students in the fields of study analysed (Figure 5.27).

**Figure 5.27 Number of students in vocational education by fields of study in 2010-2014**

*Source*: EHIS 2016. Number of student in field of study

1. Both vocational and higher education programmes are related to the professional standards of the specific specialty (if available) and from admission 2017, if available, all vocational education graduates must take the professional examination. Extensive use of outcome-based principles is applied in curricula development, implementation, elaboration and evaluation. The right to provide instruction is granted to the educational establishment through the accreditation of the curriculum groups. In the course of compiling a report for the internal performance review every school analyses the sustainability of its curricula. An independent external assessment committee conducts the external evaluation or accreditation, and, based on their report, makes their proposal about the accreditation to the Estonian Quality Agency for Higher and Vocational Education (EKKA). The Assessment Council of EKKA uses this proposal for decision-making. The results of the assessment of all educational institutions and curriculum groups are available on the EKKA database (EKKA, 2016b)
2. The needs of the labour market are taken into account when preparing and developing the curricula in the field of agriculture. Employers are involved in curriculum development, both through the curriculum boards convened specifically for curriculum development, as well as through alumni and employer surveys. In the evaluation of the study programme groups in higher and curricula groups in vocational education, cooperation with stakeholders is one of the criteria taken into account when assessing the quality of the curricula. Thus, bringing the study programmes into line with labour market relevance is mandatory in curriculum development. (EKKA, 2012; 2016)
3. Concerning higher education in rural economics, the importance of practical work experience in student development has been stressed, especially by the employers. The graduates of the higher educational institutions of 2009 and 2012 had identified the low amount of practical training as a deficiency. Only 56% of the 2009 graduates said that practical training had been a mandatory part of the curriculum, 9% of the respondents had done their practical training in the framework of an optional or elective course, and 35% of the respondents pointed out that they did not do any practical training within the curriculum (Eamets et al. 2011). Only 31% of the respondents of 2012 graduates claimed that the curriculum contained a sufficient amount of practical training in the workplace. (Laan et al., 2015)
4. As a measure for improving the learners’ practical skills, a system of practical training support has been introduced in 2005.The support is specifically meant for such entrepreneurs who take on a pupil or student studying full time and whose main occupation is studying. The introduction of practical support system has generated interest among the entrepreneurs to offer placements. As a result, the number of opportunities for the students to find up-to-date practical training will increase, which in turn will raise the quality of training (MRA, 2016g). In 2013, practical training support was allocated to 115 entrepreneurs engaged in agricultural production or the processing of agricultural products. The respective figure in 2014 was 111 and in 2015 145. Enterprises submit applications for practical training support to the Estonian Agricultural Registers and Information Board (ARIB) every year (in Sept-Oct). In 2013 and 2014, 200,000 euros were earmarked for agriculture-related practice payments, the budget for 2015 was 150,000 and for 2016 160,000 euros. The number of trainees is not limited, but the supervisor is allowed to simultaneously oversee two trainees. In case of more than one trainee, the company has to fill in the supplementary page for each trainee individually (ARIB, 2016e).
5. Labour market expectations of graduates are largely related to the number of graduates and their social skills that vocational schools and higher education institutions find difficult to meet. One of the measures (since 2003) for increasing the number of applicants for agriculture and rural economics related curricula was the introduction of study allowances for the respective students at vocational education institutes. A number of professional competitions are organised for the young people in the field of agriculture, such as ploughing competition, young farmers’ complex competition and young 262. In general, students’ interest in agricultural specialties has increased over the past decade. Despite the fact that the total number of students in vocational education decreased by about 14% in this period 2004-2014, the number of students on agriculture related curricula increased by approximately 8%, while student numbers in Social sciences, business and law, Engineering, manufacturing and building dropped by about 30% (Figure 5.15). (EHIS, 2016)
6. The “Survey on Competence Level and Educational Development Needs in Agricultural Food and Forestry Sectors” commissioned by the Ministry of Agriculture in 2010 showed that regardless of the size of the company, the demand for skilled staff (in 50% of the enterprises) and managers/specialists (in 17% of the enterprises) in the canvassed sectors will increase. 60% of the respondents from food industry pointed out that they would require almost all specialists with professional higher or vocational education, whereas the need for unskilled labour and "all-in-one" staff is anticipated to decline. The biggest problem in the rural sector in Estonia, however, is the aging of the work-force. The study also revealed that agronomists, mechanics, livestock engineers, veterinarians and milkers are the key jobs in the agricultural sector that there are currently a significant number of posts unoccupied. As to food industry, the positions of technologists, product developers, but also skilled and unskilled jobs, as well as management positions were mentioned. Most respondents expressed their concern about the shortage of skilled workers (automatician, technician), product developers, technologists and masters. The biggest problems in finding skilled staff included the attitude of the candidates, qualifications and salary expectations. (Jalak, 2010)
7. The study of Jalak (2010) found that agricultural and horticultural enterprises would like to recruit people with vocational education, but often they are not to found. On the one hand, this sector is not very attractive for young people, on the other hand, many of the employers are located in rural areas, which makes finding suitable people even more difficult. That is why enterprises have been training their workforce themselves. In contrast to agricultural and horticultural enterprises, forestry companies hold vocational training in high esteem because the machine fleet of logging enterprises is very expensive and handling the machinery needs good training.
8. The survey conducted in 2016 exposed similar problems in the agricultural sector, which still suffers from the shortage of professionals and skilled workers. The migration of young people, in the age range of 25-29, from the rural areas also causes problems. (Kurvits, 2016)
9. The survey conducted among the alumni of the Estonian universities in 2015 showed that in 2012 about 48% of the graduates of agriculture related specialties did not practice their profession, which is about 17% more than three years before (28% in 2009). Nearly 25% continued their formal studies and another 11% combined work and study. In 2012, the number of unemployed graduates was about 2%. (Laan et al., 2015) According to the alumni survey carried out in 2011, about 28% of the 2009 graduates of agricultural curricula did not work in their acquired specialty. Approximately 80% of the Bachelor-level graduates continued their studies on the Master's level and 15% of Master's graduates continued on the doctoral level. Among the unemployed graduates in 2009 was 7%. (Eamets et al., 2011) According to findings of 2011 and 2015 surveys, the main reason for the graduates of agricultural higher education to continue their studies was to pursue an academic career, earn a better salary or get an appropriate job (alumni who graduated from the higher educational institution three years ago constituted the sample).
10. The reasons for not practicing their profession were not finding a professional job, including not finding a professional job in the region of residence and giving preference to the salary and working conditions in other fields. The employer survey gave the same reasons for the shortage of skilled workers in the agricultural sector (Jalak, 2010) Average gross wages in the agriculture, forestry and fishing are smaller than the average gross salary (€ 835 and € 949 in 2013, € 913 and € 1005 in 2014, € 933 and € 1082 in 2015 and € 1,031 and € 1163 in the second quarter of 2016). At the same time, the average wages in agriculture grew faster than the national average (9.3% and 5.9% in 2013-14, 7.1% and 6.9% in 2014-2015 and 10.5% and 7.6% in 2015-16, respectively). Wages in Estonia also differ across regions, being higher in major cities and counties. (Statistics Estonia)
11. The survey carried out among the Estonian vocational school graduates in 2012 (the survey covered the 2008-2010 graduates, who were interviewed half a year after their graduation) shows that the employment rate of the graduates in the field of agriculture is higher as compared to vocational school graduates from other areas. Analysts explain the higher employment rate with the graduates’ age, which is on average higher (30+) than that of other graduates and with the fact that many graduates of agriculture were working during their studies already. According to the survey, 72% of the 2008 and 2010 graduates worked during their studies. Unlike graduates from higher education institutions, vocational graduates in the field of agriculture were more satisfied with the profession acquired, ranking their satisfaction rate higher (4.8 points out of 5) (Nestor, 2012). In the survey of higher education graduates of 2012 and 2009, on average about only 50% of respondents admitted that the studies met their expectations (mainly on the grounds that the objectives and learning outcomes of the curricula were not clear and the graduates were dissatisfied with the volume of practical training in the curriculum). (Eamets et al., 2011)
12. According to a survey of alumni of vocational schools, the graduates of agricultural specialties acknowledge the benefits of their acquired knowledge in the field of entrepreneurship, i.e. almost as highly as the graduates of the business and management curriculum group (3.6 and 3.9 points in the 5-point system). At the same time, similarly to the graduates of higher agricultural institutions, the share of vocational education graduates not practicing their profession was the highest as compared to the graduates of other curricula. The survey of 2015 revealed that the proportion of such university graduates was about 48%, and the number of vocational school graduates even lower, just 30%. The given result cannot, however, be regarded as statistically reliable as the number of respondents to this question was too small. However, the graduates of vocational education considered their professional prospects truly viable (4.2 points on a 5-point scale). (Nestor, 2012)

### Measures to address evolving labour market needs in the food and agriculture sector

1. The priority of the Estonian RDP 2014-20 ’Improving knowledge transfer and innovation in the agricultural and forestry sector and rural areas’ is closely linked with guaranteeing trained staff for the agriculture and food industry. The measures under this priority are aimed at developing the employees in this sector through training and knowledge transfer (see also Chapters 6 and 7). The activities of measure ‘knowledge transfer and awareness’ in the ERDP 2014-20 programme period include support for professional training that allow the acquisition and development of vocational, occupational and/or professional knowledge, skills and competences, as well as retraining. The measure also supports the activities that are related to the formation of study groups and making study visits tours to agricultural and forestry enterprises, allowing the participants to learn from each other's experience. The visits to companies focus, in particular, on the production methods and/or technologies in agriculture and forestry, on the diversification of agricultural production, on agricultural businesses involved in short supply chains, on finding new business opportunities and technologies, and on the improvement of forest ecological resilience. Entrepreneurs meeting at a regular basis form a study group/producer group. The measure supports the services of a consultant or a mentor, as well as meeting costs. (MRA, 2016b)
2. The programme called OSKA “A system of labour market monitoring and future skills forecasting“, which is funded by the European Social Fund, has been launched. The programme includes applied research surveys on sectoral needs for labour and skills and analyses on changes in labour requirements, labour market developments and their trends for the next ten years. The outcomes of the analyses and forecasts of labour market needs provide essential input to the qualification and career counselling system and to curricula development, as well as for various agencies funding education and training. The economic sectors to be analysed are spread out of the programme period, to 2015-18 respectively. The analysis of forestry and timber industry takes place in 2016, the analysis of agriculture and food industry is planned for 2017. The programme aims to build platforms of cooperation between employers and education providers, analyse the development opportunities and needs of different sectors of the Estonian economy, prepare labour market training requirements based on various activities or professions to facilitate the planning of education provision at different levels of education and by types of school as well as in the fields of retraining and in-service training. (OSKA, 2016)
3. In order to improve the practical skills of agricultural students, practice support measures are implemented. Practice support measures were introduced to partly compensate for the supervision and organization costs related to the practical training of students specialising in agriculture and rural economy, incurred by the farmers or processors of agricultural products. Practice support measures in fisheries are meant to partially cover the expenses associated with the practical training of students on fisheries-related curricula. To increase the number of applicants for agricultural curricula, vocational education students on the curricula related to agriculture and rural economy are paid a study allowance from the education allowance measure by the Estonian Rural Development Foundation. (MRA, 2016g)

### Education and training programmes dedicated to natural resources, efficiency of resource use, and environmental pressure (sustainable farm practices) and climate change (adaptation and mitigation); their target public (students, farmers, agri-food managers and workers)

1. Environment has been one of the main themes of the Estonia’s national curriculum already since 1996, in 2002 the area of sustainable development was added. In 2005, sustainable development was declared one of the priorities in education. Sustainable development was one of the eight themes of the new national curricula for basic and secondary schools adopted in 2011. In Estonia environmental issues are addressed at the pre-school level already: the national curriculum for pre-schools facilities includes the topic “Me and the environment”, which is one of the seven themes that develops the children's cognitive skills (such as the ability to watch nature), as well as their practical skills and values ​​(for example, giving value to health, healthy and safe way of life) (Aria et al., 2012).
2. The Ministry of the Environment together with the Environmental Board, the State Forest Management Centre and the Estonian Museum of Natural History that are under the governance of the Ministry are responsible for raising the environmental awareness of the Estonian population. Their action lines are the following (MOE, 2015):

* Supporting national curricula through non-formal environmental communication to carry out environmental education targeted primarily at the students in general education institution (including pre-school institutions) programs. The themes of the study programmes include Estonian nature, nature conservation, forestry, water management, waste management, use of mineral resources, etc. Environment and sustainable development are set out as a recurring theme in the national curricula on the primary-, basic and secondary school levels.
* Specific awareness-raising and outreach activities, derived from the objectives of environmental and nature conservation, aimed at various target groups. For example, informing the land owners of the protected areas about the nature conservation principles and practices, communicating environmental requirements to the entrepreneurs, informing the visitors of protected areas of the natural values ​​and explaining rules on the movement in nature, spreading public information on sustainable consumption, informing private forest owners about sustainable forest management and forest heritage objects, etc.
* The so-called passive environmental education includes activities that allow people to acquire knowledge about nature and the environment independently. This includes putting up information boards hikers and travellers in the nature, marking hiking and study trails and building resting places and camp sites, promoting hiking in nature and presenting good practices in hiking, and presenting natural values on the internet, online and through other e-solutions, etc.

1. Information on climate change and its impact has been rather fragmented and split up between different sectors and institutions. Given that the climate change will affect the economy, the environment, as well as the whole society, it is essential to ensure that all relevant sectors and levels of administration are involved in the elaboration of adaptation measures. A strategic framework – the Development Plan on the Adaptation to the Climate Change 2030 – has been worked out in Estonia. One of its priority sectors is Society, awareness and co-operation, which includes such fields as Education, awareness and science, Communication; Society/community; International relations and co-operation. The development plan aims to raise the willingness and ability of the society to adapt to the impacts of climate change on the national, regional and local levels. The measures listed under the sub-sector Society, awareness and cooperation support pre-school, general education establishments and hobby schools, environmental education centres and vocational training institutions in adapting to the impacts of climate change, ensure the availability of up-to-date and comprehensive information on climate change, including the spillover effects of the global climate change on Estonia. The above-mentioned measures are intended to support the development of training materials related to civil protection and the adaptation to the climate change, engage teachers and educational specialists in capacity building activities so that they can address the topic of climate and climate change adaptation in the study process; the development, elaboration and running of climate change-related study programmes; climate research; and the participation of Estonian scientists in international climate change-related research programmes and cooperation initiatives. (MOE, 2016b)
2. Regular studies into the environmental awareness of the population of Estonia have been carried out every two years from 2010 (in 2010, 2012, 2014 and 2016). The studies focus on the following aspects of environmental awareness and attitudes: the assessment of the current environmental status and the main challenges; the reliability of the environmental institutions and the image of the Ministry of the Environment; the perceptions of environmental protection in Estonia; the attitude towards different sources of energy; environmentally friendly behaviour; environmental awareness and sources of information; awareness of ecolabels and attitudes towards climate change. Environmental Awareness Index was the highest in 2016 (42.0 points), in 2014 37.5 points and in 2012 37.9 points. The attitudes of the respondents from Ida-Viru County differed from the others, standing out for their markedly pessimistic undertone. They rated the status of the environment in Estonia as a whole, as well as the situation in individual areas, lower than the average. Availability of environmental information also causes problems, which might also explain the lower confidence of the inhabitants in the opinion leaders and in different environmental institutions in the region. Research has shown that young people aged 15- 19 are the best informed about the topic of climate change. The results of the study allow to conclude that over the four-year period (2012-2016) the views on different sectors have generally improved. Considerable improvement can be detected in the following areas: reducing industrial pollution from large enterprises, eco-friendly construction, mining, ambient air quality and accessibility to clean drinking water. (MOE, 2016c)
3. In formal education, the use of natural resources, sustainable agriculture, environmental protection and climate change-related disciplines ae taught at Bachelor’s, Master’s and Doctoral levels (Table 5.6).

**Table 5.6. Study programme groups related to environmental issues (as of 19.05.2016)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Vocational education** | **BSC** | **MSc** | **PhD** |
| Applied biology of aquatic and terrestrial ecosystems |  | EMU | EMU |  |
| Natural Resources management |  | EMU | EMU |  |
| Environmental sciences and applied biology |  |  |  | EMU |
| Environmental protection | Räpina Scool of Horticulture | EMU |  |  |
| Biology and biodiversity conservation |  | University of Tartu |  |  |
| Ecology and biodiversity conservation |  |  | University of Tartu |  |
| Environmental technology |  |  | University of Tartu | University of Tartu |
| Environmental management |  | Tallinn Technical University | Tallinn Technical University |  |
| Ecology |  |  |  | Tallinn Technical University |
| Management of the environment |  | Tallinn Technical University |  |  |
| Industrial ecology |  |  | Tallinn Technical University |  |

Source: EHIS (2016b)

1. In 2011, the programme “Development of Environmental Education” which was co-financed by the ESF, was launched. The program was designed to give an impetus to the development of environmental education both in formal, non-formal and informal education. The important aim of the programme was to offer training courses for the teachers and teaching staff in formal education, as well as for the professionals providing out-of-school environmental education. During the programme a cooperation network in environmental education was developed so that the formal national curricula and the non-school environmental education would support each other and the development of environmental education in Estonia would be systematic and sustainable. The program lasted until 2015 (Environmental Board, 2016).
2. The Environmental Board (EB) also promotes environmental education for school-children. The EB maintains nature centres and environmental education support points all over Estonia. For schools, participation in the programs is offered free of charge. There are nine nature centres with comprehensive permanent exhibitions introducing the nature and cultural heritage of the area and facilities for carrying out for environmental education programs. The mobile centre in the form of an environmental education bus offers additional possibilities for environmental training in the Harju, Järva and Rapla counties. The EB has developed more than 100 different environmental academic programmes, which help to tie in the knowledge and skills acquired at school. The study programs of the EB are in line with most of the topics in the curricula in natural sciences. The programmes are built on the principles of active learning – the students gain knowledge and experience through practice. (Environmental Board, 2016)
3. A new course of action for the EB is introducing the fields of activities under their governance schools (waste management, mining, fishing, hunting, water protection, air protection, protection from radiation) at schools. For that purpose programmes that can be carried out in schools, in the vicinity of schools or at the environment-related enterprises - waste collection points, landfills, water treatment plants, etc. are being worked out. For example, the schools will be able to order a thematic study programme on waste separation and recovery from the environmental education specialist of the county (Environmental Board, 2016).
4. In addition, students across Estonia can participate in different environment-related hobby groups. There are a couple of dozen hobby groups, which programmes are based on the curricula related to environment and nature operating in Estonia (as of 05.19.2016, curricula registered in EHIS). Most of the hobby groups specialise in nature and only a couple of the hobby groups focus on the issues of environmental protection (in Tallinn and Tartu) (EHIS, 2016b).
5. A recent study “Education for Sustainable Development and Its Promotion”, conducted in 2012, demonstrated that a number of elements supporting sustainable development in the Estonian national curriculum for basic education are relatively well represented. These topics are sustainability and sustainable development, health, cultural diversity and the stock of natural resources. In addition to sustainability and sustainable development, such economic elements as production and consumption are rather well covered, whereas such themes as poverty, exhaustion of the natural resources on the planet, corporate social responsibility and market economy issues have found far less expression. As to environment-related elements the stocks of natural resources are predominantly discussed. Some attention is paid to biodiversity and the concept of human as a biological creature. Less consideration is devoted to the issues related to agriculture, natural disasters, climate change, air quality, and the development of rural areas. The approach to sustainable development in the national curricula is relatively one-sided, without facilitating a comprehensive understanding. The skills and values promoting sustainable development in the curricula are not addressed in an integrated way, only a few key aspects (understanding the complexity of the world, respect and responsibility) are highlighted, while change management, cooperation skills and basic science skills are ignored (Aria et al., 2012).
6. As to Education for Sustainable Development and Its Promotion programme, it must be pointed out that the programme does not have impact indicators, but only performance indicators. It can be indirectly assumed that the promotion of environmental education will, in the long term, lead to sustainable use of natural resources, cut the pollution load and reduce health risks arising from environmental risks. It can also be logically assumed that environmental education allows to influence the impact of human activities on the environment by avoiding environmentally harmful decisions and reducing the environmental burden through behavioural changes.

## Summary

* The physical infrastructure in Estonia is relatively good. But there are some problems with the availability and quality of infrastructure, especially in rural areas. Excessive pricing of grid connection and electricity capacity upgrading are the main problems. Since electricity grid connection is expensive, the use of off-grid solutions or stand-alone power systems are considered for sparsely populated regions.
* Estonia's main roads are mostly in a good or very good condition, basic roads in a satisfactory condition, whereas the secondary and local roads are in a rather poor condition. Transport Development Plan 2014-2020 aims at reducing the proportion of secondary and local roads in poor and very poor condition.
* Estonia is located in a temperate climate zone, where the amount of precipitation significantly exceeds total evaporation. Humid climate, flat terrain, unevenly distributed natural hydrological network and soils with poor permeability contribute to widespread paludification. More than half of the UAA is covered by land drainage systems. Most of the drainage systems are over thirty years old and need reconstruction. In 2005, 26% of the draining systems were in a poor condition.
* Scores for mobile telephone subscriptions are very high and for internet use relatively high (80% of individuals use internet). Almost all companies use computers and almost all enterprises have broadband Internet connection. Since 2010, Estonia has been rapidly developing the basic broadband infrastructure (passive optical network) with the EU support. The problem lies in making high-speed broadband access to the Internet network accessible to the end uses. As of autumn 2016, only 10% of the fibre optic capacity of basic broadband infrastructure was exploited (it is possible to use OC24 or OC48 throughout the entire passive optical network).
* To develop the technical infrastructure EU structural funds support is used, with the exception of electrical grid infrastructure, which is financed from electricity transmission charges. PPP is not applied in the development of technical infrastructure.
* Urbanization and population concentration in Tallinn and the surrounding municipalities has led to the aggregation of services, including public services, to the regional centres, instead of rural municipality and county centres, which has worsened the physical accessibility and the quality of services in rural areas. On the other hand, the volume of certain physical public services has been reducing due to the spread of internet, improvement of computer skills and the development of public e-services.
* Demographic forecast shows that the population of Estonia is still aging and the birth rate continues to decline, which in turn leads to a reduction in the number of students at different levels of education. The number of students has decreased more than 10% over the past ten years and this trend is expected to continue. The demographic downward trend has had a diverse effect on the number of students in different study programme groups in higher and vocational education. The general trend in the number of students enrolled in vocational training in Estonia has been downward, but for example in the field of agriculture, the number of students has been growing in the past decade. In higher education, the number of students enrolled in agriculture has declined over the past decade. However, proportion of students studying agriculture of the total number of students has remained relatively stable.
* The age structure of students in vocational education is changing. More and more adult learners over 30 years of age are entering vocational education. For many years the number of adult learners has remained relatively stable in higher education. The upward trend in the number of adult learners is projected to continue, thus it can be assumed that the demographic developments do not have a one-to-one effect on the decrease in number of students in vocational and higher education. Increase in the average age of learners fosters better informed choices regarding the choice of their specialty, so it can be predicted that the area of specialization will be better linked to the student’s professional career in the future.
* In Estonia noticeable changes can be detected in the in the establishment structure in recent decades: the share of skill-intensive positions has grown and the employment structure is moving towards fully skilled jobs. As compared to towns, the number of working age with lower level of education is higher in rural settlements and the overall employment rate in the countryside is lower than in the city, which is why skilled workers are harder to find in rural areas. The aging of the labour force in the agricultural sector and the migration of young people (aged 25-29) from the rural areas, which has contributed to better wages and working conditions in the city, causes problems in Estonia. At the same time, in recent years the average wages in agriculture have grown faster than the national average. An increase in the average wages and a more conscious choice of profession is expected to have a positive effect on the choice of their professional career made by younger people in the rural areas.
* The system for labour market monitoring and forecasting future skills launched in Estonia contributes to the curriculum development, which takes into account the needs of the labour market. The systems includes the establishment of a cooperation platform for employers and educational and training institutions, makes a comprehensive analysis of the development opportunities and needs of different economic sectors in Estonia, and studies labour market training requirements based on various activities or professions, draws up training plans at different levels of education and for a variety of educational institutions, including retraining, in-service training and refresher courses. To increase the students’ motivation, study allowances are paid to students on the agriculture-related curricula in vocational education and specialisation scholarships are available for students in higher education and practical training support helps to improve the learners' practical skills.
* To ensure the sufficient number of professionals entering agricultural labour market, vocational and higher education institutions must be more effective and focused in promoting their speciality and profession in schools and in the society at large, which requires the elaboration of a more comprehensive and systematic outreach system at educational establishments. A more efficient and systematic involvement of employers and professionals of the specific field in curriculum development will help to guarantee that the knowledge and skills of graduates will take into account the future needs of the labour market and meet the expectations of professionals.
* The Estonian labour market stands out in particular, by wage flexibility and a high proportion of women in the labour market and from the social point of view, it would be important to focus on attracting and retaining talent. The Employment Contracts Act adopted in 2009 has significantly fostered the flexibility of the labour market.
* The rise in unit labour costs creates unemployment as companies are unable to pay high salaries to everybody and, as a result, the competitiveness of the country goes down and the economic growth moderates.
* Decrease in labour productivity, however, is related to cheaper labour as compared with neighbouring countries, which attracts new companies, but does not create an incentive for technology-intensive investments and smart job creation and hinders growth in productivity.
* Alleviation of the terms for recruiting temporary seasonal workers from other countries would enhance the competitiveness of agriculture. As horticulture is a very labour intensive branch of agriculture, horticultural producers have been very active in fighting for the adoption of the new directives.
* In the light of climate warming (an increase in precipitation, etc.), it is important to support the farmers in the reconstruction and renewal of drainage systems.
* The construction of a permanent Internet connection system in sparsely populated areas is expensive, which means that it is not economically viable for the operators and affordable for the consumers. Therefore, it is necessary to find the opportunities to ensure the end consumer access to broadband at the national level, and decide which technologies should be employed.

# Agricultural policy

## Agricultural policy framework

*Domestic agricultural and associated trade measures affect farm investments and practices through a variety of instruments, with different intended and unintended impacts on structural change, natural resource use and innovation.*

*A policy instrument will affect business decisions by changing the relative prices of inputs and outputs. For example, investment support lowers the price of land and capital and could thus facilitate structural change and investment in new technologies. The path of productivity growth and sustainability outcomes will then depend on both market and other policy incentives and disincentives.*

*Sustainability outcomes are linked to the way natural capital, which is the source of service flows entering the production process, or ecosystem services, is being priced and used. In cases where public policy is deficient to address these market failures in pricing natural assets, which often have common pool, externality or public good characteristics, there is a risk that innovation systems and productivity growth in agriculture follow a non-sustainable pathway, leading to progressive depletion of natural assets, which may not be substituted by other forms of capital or by labour. In such cases, there would be a trade-off between productivity growth in the short-run and in the long-run.*

### The main policy framework

1. Estonia is an EU member state since 2004. Therefore, the main agricultural policy framework is strongly related to the EU Common Agricultural Policy (CAP). Numerous agricultural and food sector and sub-sector strategies have been laid out (see also Figure 7.6), that have been used in setting policy priorities regarding implementation of CAP Pillar 1 and 2 measures in 2014-20, given the flexibility offered by the CAP framework.

### Current programmes and funding mechanisms

1. Following the general structure of the CAP, the programmes and funding are laid out in two pillars. Pillar 1 includes common market organisation (CMO) that provides market support and direct payments. Pillar 2 includes rural development support which is implemented according to national Rural Development Plan (RDP).
2. For the period 2015-20, the National ceiling of direct payments in Estonia is 897.2 million euros (Table 6.1) (Regulation (EU) No 1307/2013). Estonia decided to transfer 10.8% of the National ceiling to Pillar 2. Of the remaining Pillar 1 budget of 799.9 million Euros, 65.5% is allocated for flat rate basic payment (under single area payment scheme) conditional on maintaining agricultural land in good agricultural and environmental conditions (i.e. following the cross compliance rules) and 30.0% is allocated for mandatory greening payments; 4.1% is allocated for the voluntary coupled support (VCS), and 0.3% to young farmers’ scheme (YFS) (European Parliament, 2015; communication from MRA). Estonia is one of the EU member states that is allowed to pay transitional national aid in addition to the National ceiling that is financed from the European Agricultural Guarantee Fund (EAGF). However, in 2014-16, the Government decided not to utilise this opportunity. The new government that assumed office in November 2016, aims to pay transitional national aid in the maximum amount, starting from 2017 (Government, 2016b).
3. In 2015-16, VCS was paid to households that have ≤100 cows; for heards that have ≤25 suckler cows and heifers of up to 8 months of age; for ewes and sheeps in herds with 10-100 ewes or she goats that are at least 1 year old; for growing fruits and vegetables on at least 1 ha of land (MRA, 2015f; RT I, 22.04.2015, 30; RT I, 22.04.2016, 2). For the period 2017-20, due to the difficult situation in the milk farming sector, MRA plans to increase the payment rate for households that have ≤100 cows, and introduce a payment for households that have 100<…≤400 cows. According to the plan, VCS for suckler cows and heifers, and for ewes and sheep will be abolished (MRA, 2016k).

**Table 6.1. Breakdown of CAP Pillar 1 Estonian National ceiling, million euros, 2015-20**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total |
| Basic payment | 75.5 | 75.6 | 80.0 | 87.2 | 94.2 | 111.9 | 524.3 |
| Greening | 34.3 | 34.4 | 37.1 | 40.2 | 43.2 | 50.8 | 240.0 |
| Voluntary coupled support | 4.2 | 4.2 | 6.1 | 6.1 | 6.1 | 6.1 | 33.0 |
| Young farmers' scheme | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.6 | 2.6 |
| Transfer to pillar 2 | 7.5 | 19.1 | 21.8 | 23.5 | 25.4 | 0.0 | 97.3 |
| National ceiling | 121.9 | 133.7 | 145.5 | 157.4 | 169.4 | 169.4 | 897.2 |

Source: compiled on the basis of Regulation (EU) No 1307/2013, European Parliament (2015), and communication from MRA

1. Estonian agricultural producers witnessed increase in direct payments from 2004-12 (Figure 6.1). Only in 2009, when economic recession was deepest the amount of direct payments decreased. From 2012 onwards the direct payments have decreased. In 2014-16, the main reason being the government’s decision not to pay transitional national aid. However, as can be seen from Table 6.1, and according to the plan of the new government (Government, 2016b), in coming years the direct payments will increase. The amount of direct payments in real prices (current prices divided by agricultural input price index, 2004=100) in 2014 and 2015 was below the 2007 level. From 2008 onwards the value of direct payments as a percentage of agricultural output (in current prices) has declined from 18.2% in 2008 to 11.6% in 2015.

**Figure 6.1. Developments in direct payments in Estonia, 2004-15**

Source: communication from MRA, Statistics Estonia (2016)

1. The indicative budget of Estonian RDP in 2015-2020 is 992.8 million euros, of which 36.8% is related to priority ‘4. Ecosystem management’, 28.6% of the budget is allocated to priority ‘2. Competitiveness’, 17.7% to priority ‘6. Social inclusion and local development’, 10.6% to priority ‘3. Food chain’, and 2.4% of the budget is related to priority ‘5. Resource efficiency and climate change’. 3.9% of the RDP budget is allocated for technical assistance, i.e. implementation of the RDP (Table 6.2). RDP is implemented in 14 measures that contribute to the indicated priorities. One measure can be related to several priorities. Measure ’04 Investments’, that is related to all RDP priorities, comprise 29.2% of the RDP budget; the share of measure ‘10 Environment’, which is related to the priority ‘4. Ecosystem management’, is 24.7%; and share of measure ’06 Farm development’, which is related to priorities ‘2. Competitiveness’, ‘5. Resource efficiency and climate change’, and ‘6. Social inclusion and local development’ is 12.3% of the total RDP 2014-20 budget.

**Table 6.2. Indicative budget of Estonian RDP, 2015-20**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Priorities | | | | | | Technical assistance | Total | % of total |
| Measures | 1. Knowledge transfer and innovation | 2. Competi-tiveness | 3. Food chain | 4. Ecosystem management | 5. Resource efficiency and climate change | 6. Social inclusion and local development |
| 01 Knowledge |  | 2.3 | 3.2 | 4.6 | 1.9 |  |  | 12.0 | 1.2 |
| 02 Advisory |  | 5.4 | 0.2 | 0.7 | 0.4 | 2 |  | 8.7 | 0.9 |
| 03 Quality schemes |  |  | 1.0 |  |  |  |  | 1.0 | 0.1 |
| 04 Investments |  | 212.0 | 50.0 | 2.5 | 8.0 | 17 |  | 289.5 | 29.2 |
| 06 Farm development |  | 52.1 |  |  | 3.0 | 67 |  | 122.1 | 12.3 |
| 08 Forest |  |  |  | 1.0 | 9.0 |  |  | 10.0 | 1.0 |
| 09 Producer groups |  |  | 6.0 |  |  |  |  | 6.0 | 0.6 |
| 10 Environment |  |  |  | 244.9 |  |  |  | 244.9 | 24.7 |
| 11 Organic |  |  |  | 77.7 |  |  |  | 77.7 | 7.8 |
| 12 Natura |  |  |  | 32.7 |  |  |  | 32.7 | 3.3 |
| 14 Animal welfare |  |  | 40.6 |  |  |  |  | 40.6 | 4.1 |
| 16 Cooperation |  | 11.7 | 4.0 | 1.5 | 1.5 |  |  | 18.7 | 1.9 |
| 19 LEADER |  |  |  |  |  | 90 |  | 90.0 | 9.1 |
| 20 Technical assistance |  |  |  |  |  |  | 38.9 | 38.9 | 3.9 |
| **Total** |  | **283.5** | **105.0** | **365.6** | **23.8** | **176** | **38.9** | **992.8** |  |
| % of total |  | 28.6 | 10.6 | 36.8 | 2.4 | 17.7 | 3.9 |  |  |

Source: European Commission (2015)

### Evaluation of agricultural policy measures – impact of agricultural measures on the adoption of innovation, structural change, and the state and sustainable use of resources at farm and industry level; results of recent evaluations

1. During the programming period of Estonian RDP 2007-13, for the first time, an ongoing evaluation was carried out, that provided analyses and feedback on the implementation and results of the RDP. During the compilation of Estonian RDP 2014-20, an ex-ante evaluation was carried out. In parallel, a strategic environmental evaluation was done. Several recommendations of the strategic environmental evaluation were implemented in designing the measures of the RDP 2014-20. The results of ongoing evaluation were used as an input in the process of ex-ante evaluation (MRA, 2015a). Monitoring and evaluation system of RDP is explained also in chapter 7 (e.g. see Figure 7.10, Tables 7.2 and 7.3)
2. In the SWOT analysis section of the RDP 2014-20, among others, the following conclusions have been drawn in relation to innovation, structural change and sustainable use of resources (MRA, 2015a):

* From 2005-12, the labour productivity in primary sector increased by marked 53.3%. Structural changes, improvement in efficiency and intensification of production were the main sources of the labour productivity growth.
* Insufficient communication of R&D results and lack of cooperation between different parties in innovation activities hinder knowledge transfer from science to practice, as well as awareness of scientists of the practical problems of enterprises. In longer term, this could hinder the competitiveness of agriculture. Therefore, promotion of cooperation between research groups, agricultural producers, entrepreneurs and advisors is needed.
* In the fields of agriculture and rural economy, various training and knowledge transfer activities should include, among others, the themes related to management, maintenance of agricultural land, and agri-environment. In the programming period 2007-13, there were not enough trainings on themes important to the state, such as climate change and water protection.
* In developing the advisory system, the advisory centres should increase cooperation between themselves, coordinating centre, R&D institutions and various speciality organisations.
* Hiring and training of new advisors is necessary, especially in the fields of adaptation to climate change and innovation.
* Purposeful use of 55% of UAA is possible only if drainage systems function properly. Most of the drainage systems are more than 30 years and require renovation and reconstruction. From 2004-13, 15% of required reconstruction and 25% of required renovation was done with the help of RDP funds.
* Considering the positive results of support measure for young farmers, but acknowledging the insufficient share of young farmers, the entry of qualified and experienced (in agriculture) younger farm managers’ generation should be supported (both, from I and II pillar measures).
* While organic production has developed and 15% of agricultural land is organic, more attention should be paid to developing the supply chain in a way that more correctly labelled organic products reach the end consumers.
* Food processing industry needs to reduce export of raw materials or low value added products and increase the export of high value added products. Also, the range of export partners should be expanded in order to reduce risks.
* In addition to insufficient investments into fixed assets, Estonian food processing industry lacks capacity to make production process more knowledge intensive.
* Several recommendations have been made in relation to biodiversity and landscapes (farmland birds, landscape elements, local breeds and varieties, semi-natural habitats, Natura 2000 agricultural land, high nature value agricultural land), water protection and management (use of pesticides, nutrient leaching, manure storage and spreading, manure spreading equipment, nitrate vulnerable zone, organic production), soils (loss of organic matter, low K and P reserves in soils, reduction of cultivation on peat soils, liming of soils, water erosion), energy efficiency (more efficient use of motor fuels), renewable energy and use of residues, reduction of GHG emissions (biogas production, more efficient use of N fertilizers, climate friendly cultivation techniques, environmentally friendly management of peat soils, manure storage and application, improve CO2 sequestration).
* Availability and quality of high speed internet connection should be improved in rural areas.

1. Therefore, the results of various analysis and impact assessments were considered in developing the Estonian RDP 2014-20. E.g. RDP 2014-20 includes sub-measures ‘Innovation clusters’ and ‘Long-term programmes of knowledge transfer’ where applicants should form a consortium consisting multiple partners from R&D institutions, agricultural producers, food processors, advisory system, vocational education institutions and other stakeholders. Also, the advisory system was reformed, and the role of the coordinating centre was given to Rural Development Foundation. Young farmers will be suppored from CAP pillars I and II. Budget of RDP 2014-20 measures that target food processing industry is larger compared to the RDP 2007-13.
2. During the implementation of RDP 2014-20, an ongoing evaluation will be continued to evaluate the extent that the aims of the RDP are achieved and make recommendations as how to makes RDP support measures more effective.

## Broad-based domestic measures

*Measures that distort markets, such as border protection, supply controls, output-based payments reduce producers’ incentives to use production factors more productively. As such, they hinder structural adjustment and discourage producers to innovate to become more competitive. These distorting measures can maintain resources in the sector that would otherwise be reallocated to more productive uses; they can encourage more intensive production, sometimes on marginal or fragile land; and they can encourage production practises that do not always take adequate consideration of longer term environmental sustainability. By rising production costs for domestic food processors, they may stimulate innovation in processes and products.*

*Broad-based income support decoupled from commodity production is more effective in transferring income to producers and thus increasing their capacity to invest and innovate. It also leaves more flexibility to producers to undertake new activities and switch to new products. However, even if decoupled from production choices and targeted, income support slows structural adjustment needed to facilitate economies of scale, attract new entrants and thus foster innovation and productivity growth. If conditional on the adoption of environmentally-friendly practices, this support can improve sustainable resource use.*

### Instruments for supporting prices and income, and their implementation parameters (e.g. eligibility, support rate, conditions attached to the granting of income support); generation of price transfers

1. The main income support instruments are direct payments. As indicated in Table 6.1, the basic payment, implemented as flat rate simplified area payment scheme (SAPS) comprises the main part of direct payments (75.5 million euros in 2015). In addition, 34.3 million euros of payment for agricultural practices beneficial for the climate and environment (greening) was paid in 2015. VCS amounted to 4.2 million euros in 2015. Young farmers scheme amounted to 0.3 million euros. The annual payment for young farmers is calculated as 25% of the single area payment per hectare multiplied by the number of eligible area, but no more than 39 ha (Parliament of Estonia, 2014). The support rates of direct payments in 2015 are given in Table 6.3.

**Table 6.3. Support rates of direct payments in 2015**

|  |  |
| --- | --- |
| **Direct payment scheme** | **Support rate** |
| Simplified area payment | 79,51 euro/ha |
| Payment for agricultural practices beneficial for the climate and environment (greening) | 36,14 euro/ha |
| Young farmers scheme | 19,87 euro/ha |
| VCS for growing fruits and vegetables | 572,86 euro/ha |
| VCS for dairy cows | 130,80 euro/cow |
| VCS for suckler cows | 91,32 euro/cow |
| VCS for ewes and goats | 15,88 euro/animal |

Source: ARIB (2015)

1. The following EU market regulation measures were applied in 2015 (OECD, 2016b):

* School milk support – in 2015, school milk support totalled 1.52 million euros.
* School fruit and vegetables scheme – in the schoolyear 2014/2015, payments were made in the amount of 0.84 million euros.
* Intervention stocks of cereals and dairy products – in the period of 2014/2015, no cereal or dairy products intervention purchases were made.
* Private storage aid – in 2015, the total amount of private storage aid for pig meat was 0.16 million euros.
* Export refunds – in 2015, no export refunds were paid.
* Honey production and market development programme – in 2015, the programme budget amounted to 0.155 million euros.
* Information provision and agricultural products promotion measures – in 2015, Estonia had three information and promotion programmes running: the programme for fresh fruit and vegetable (0.058 million euros in 2015); the promotion programme for fresh milk and dairy products (0.143 million euros in 2015); programme for providing information and promoting grass-fed beef in Sweden and Latvia (0.041 million euros in 2015).
* Production quotas – the EU milk quotas expired in 31 March 2015. In the quota year 2014/2015, Estonian producers exceeded the milk quota by 1.2%. This caused dairy farmers to pay surplus levy in the amount of 2.2 million euros.
* Exceptional aid to milk producers and pig sector – the exceptional aid to milk producers in the Baltic States and Finland, decided by the European Commission in November 2014, was paid in February 2015 in the amount of 6.87 million euros. Due to the deteriorated livestock market situation in 2014 and 2015, in October 2015, the EC decided to grant exceptional aid to livestock producers. The amount allocated to Estonian producers was 7.56 million euros. This was complemented by additional support from the Estonian state budget in the amount of 7.56 million euros. The first part of the aid (10.56 million euros) was paid to milk and pig farmers in December 2015, the second part (4 million euros) in February 2016.
* Exceptional aid to the horticulture sector – the compensation for non-harvesting (508 tons of carrots, 130 tons of cabbage, 9 tons of blueberries, 6 tons of apples) amounted to 0.022 million euros in 2015.

## Domestic measures targeting specific issues

*Some measures aim to address specific issues in response to perceived market failures, regarding access to inputs or environmental externalities, which are not correctly valued by markets. Some measures are based on input use (variable inputs, capital and services). They include risk management measures, investment support, or support to (advisory, technical) services to producers.*

*Iinvestment support can support adjustment by facilitating investment in modern technology or additional inputs needed to increase economies of scale, and thus productivities. It can be targeted to the purchase of innovative or more sustainable technologies, but even if it is not, other market and policy incentives can guide investment in these areas.*

*Agricultural producers face risks, which result in variable outcomes. Support for risk management can be considered as reducing the cost of risk for farmers. Risk management essential to improve adoption of innovation and more sustainable practices that could increase risk exposure.*

*Agricultural measures that support innovation directly are likely to create stronger incentives and capacity for innovation among agricultural producers and will help structural change. Providing farmers with the skills and tools to better manage economic and environmental risks is also very important to promote the adoption of innovation, but care should be taken that risk management measures do not delay adaptation.*

*Some agricultural policy measures aim to facilitate resource allocation within the sector and across sectors. They include early retirement schemes, and investment assistance for new entrant, for farm enlargement or for diversification of activities.*

*Agricultural policy instruments that support explicitly the adoption of more sustainable technologies or practices (agri-environmental measures) or measures to adapt and mitigate climate change, and are often associated with regulation and market-based mechanisms. They are likely to steer farmers towards innovative sustainable practices more effectively. In the long-term, they are also likely to guide the content of innovation in the direction of sustainability.*

### Instruments for supporting variable input use, investments and services to producers, their implementation parameters (e.g. eligibility, support rate, conditions attached to the granting of support); the share of support in farm receipts

1. In 2015, the payments based on variable input use amounted to 26.68 million euros (OECD, 2016b):

* The main instrument related to variable input use is a fuel excise tax exemption for agricultural producers for using diesel fuel marked with fiscal marker in the machinery used in the process of agricultural production. The exemption amounted to 26.0 million euros.
* Insurance subsidies amounted to 0.01 million euros.
* Support for the replacement of agricultural producers amounted to 0.5 million euros.
* Private storage aid for pig meat amounted to 0.16 million euros.
* Three-year instalment of the milk quota super levy at 0% interest rate amounted to 0.17 million euros.

1. As indicated in Table 6.2, investments and farm development comprise 41.5% of the Estonian RDP 2014-20 budget. The following measures and sub-measures are available (MRA, 2016b):

* 4. Investment in physical assets
* 4.1. Investments into improving the performance of agricultural holdings
* 4.2. Investments into processing and marketing of agricultural products
* 4.3. Investments into development and maintenance of agricultural and forestry infrastructure.
* 4.4. Support for reconstruction of stone fences.
* 6. Farm and business development:
* 6.1. Start aid for young farmers
* 6.3. Development of small farms
* 6.4. Support for the diversification of rural economy towards non-agricultural activities.

1. Measures classified under the General Services Support Estimate (GSSE) amounted to 39.9 million euros in 2015. Following categories of GSSE can be outlined (OECD, 2016b):

* Agricultural knowledge and innovation system – the support amounted to 18.1 million euros.
* Inspection and control – 16.4 million euros was spent.
* Development and maintenance of infrastructure – the support amounted to 2.7 million euros.
* Marketing and promotion – the support amounted to 2.1 million euros.
* Cost of public stockholding – the costs amounted to 0.5 million euros.

### Government support to risk management tools

1. In 2008, insurance support measure was introduced. The measure compensates partially (50-80%) insurance payments for agricultural crops, agricultural animals, poultry and bees to small and medium sized enterprises. In 2015, the compensation rate was 65% of insurance payments, and the support amounted to 0.01 million euros (OECD, 2016b). In 2015, 1,659 cattle (0.6% of total number cattle) and 2,050 pigs (0.7% of total number of pigs) were insured within the scheme. Insurance for agricultural crops is not provided in Estonia.

### Provisions to help farmers deal with the consequences of natural disasters

1. In 2015 and 2016, compensation was paid to pig farms whose herds were culled, and feed and equipment were destroyed due to the diagnosis of African swine fever. In 2015, the compensation amounted to 1.9 million euros (OECD, 2016b). According to the Infectious Animal Disease Control Act, the following damage shall be compensated to keepers of animals in the events (RT I 1999, 57, 598):

1) the value of an animal slaughtered on the basis of a precept, including diagnostically slaughtered, killed or deceased due to an infectious animal disease;

2) the value of equipment, feedingstuffs, packaging materials, and animal products destroyed on the basis of a precept.

1. The damage caused by wild animals and birds are compensated by the Environmental Board.

### Measures for improving adoption of innovation – e.g. credit for investment in farm-level or firm-level innovation, incentives to adopt specific (e.g. green) technologies and practices, support to diversification of activities, risk management

1. Adoption of new technologies is supported through RDP measures 4. Investment in physical assets, and 6. Farm and business development.
2. Innovation is in the focus of RDP measure 9. Cooperation that includes sub-measures: Innovation cluster; Short supply chains and development of local markets; Development of new products, practices, processes and technologies. These measures aim to support the cooperation of farms, food processing industry, R&D institutions and other actors in finding innovative solutions relevant for the whole agricultural and food sector or sub-sector, or individual enterprise or group of enterprises.

### Measures for facilitating structural adjustment in the food and agricultural sector

1. In the farming sector, structural adjustment is facilitated mainly via the RDP measure 6.1. Start aid for young farmers, the aim of which is to support new entrants and transfer of farm management to younger and well prepared managers.
2. In the food sector, formation of producer groups is supported via the RDP. Also, the RDP includes a sub-measure targeted to financing a large projects, i.e. large-scale (with support 2-15 million euros) investment into processing facility. Only such applicants are eligible, in which producer cooperatives own majority of shares.

### Specific environmental policy instruments (tax, subsidy, etc.) in agriculture (e.g. water, greenhouse gas, biodiversity) in complement with general regulation on natural resources and environmental protection

### Characteristics of recent agri-environmental policy instruments: Scope, Coverage, Tax or subsidy rate and formula (or cap for cap-and-trade systems); Allocation of collected revenue

1. Until 2014, the most important agri-envionment schemes supporting sustainable agriculture in Estonia were environmentally friendly management (EFM) and organic production[[8]](#footnote-9). The EFM or organic farming support applicant must perform their agricultural activities on the agricultural land and in the entire household in compliance with the all the requirements, as well as the respective basic or additional EFM or organic requirements, dependent on which support is applied for. (ARIB, ARIB, 2016b; RT, 2015; VFB)
2. The EFM support rate for the basic requirements package is 50 euros/ha, additional support for implementing additional water protection activities 5 euros/ha and additional support for creating ‘bee pastures’ is 100 euros/ha. The EFM basic scheme requirements are as follows (ARIB. Infoleht "Keskkonnasõbraliku majandamise toetus" 2016):

* To ensure crop rotation the same type of crop or vegetable can be grown in the same field in up to two consecutive years, cereals in up to three consecutive years and cruciferous crops in every fourth year.
* The applicant grows leguminous crops on at least 15% of the land subject to support either in pure culture, in a mixture with graminaceous grasses, or in a mixture with other agricultural crops used as green fertilizers. Undersowing of legumes is allowed.
* The applicant keeps at least 30% of the land subject to support from 1 November to 31 March the following year under winter vegetation.
* At least 15% of cereal crops are sown with certified seed (in spring and winter in total).
* The application of glyphosates is prohibited from the time of emergence and planting of cultivated plants and vegetables until harvesting. It is also prohibited on green fallows and grasslands used as green manures and on fields where the pastures for bees are established with the help of EFM support.
* The applicant arranges the collection of soil samples at least once during the obligation period and sends the soil samples to an accredited laboratory.
* The applicant draws up a fertilisation plan by June 15 for the whole UAA.
* The applicant or his/her representative must participate in the EFM basic training by December 1 of the first year of the obligation period and in and EFM extension training by June 15 of the fifth year of the obligation period.
* If the area of arable land (under crops or vegetables or unplanted fallow) is larger than 20 ha and borders with a public road, the applicant must leave or establish a 2–5 m wide grassland strip with perennial vegetation or other kind of landscape element between the field and public road.

1. EFM is one of the five sub-measures of the ERDP 2014-2020 agri-environment support, where the European Council Regulation 1305/2013 provides for the maximum amount of support per hectare. In the period, 2014-20, ORG is not a sub-measure of agri-enviromental scheme. Therefore, the maximum ha peayment for ORG is considered separately, according to the EU regulation 1305/2013. The maximum rates for both EFM and ORG are (ARIB, 2016a; ARIB, 2016c):

* 600 euros/ha for annual crops (this group includes cereals, oil and fibre crops, other industrial crops, vegetables, intertillage crops, roots, vegetables and unplanted fallow);
* 900 euros/ha for perennial crops (including all the medicinal and aromatic herbs, strawberries and orchards and berry gardens);
* 450 euros/ha for other land use (includes all fields with the land use patterns of permanent grassland, environmentally sensitive permanent grassland, field crops and grasses, and semi-natural grasslands).

1. In Estonia, EFM support has been paid to agricultural producers, who undertook the obligation to comply to additional restrictions since 2001. The payments compensate for all or part of the loss of income and the additional costs associated with the additional environmental constraints. Before joining the EU, the measures were tested in pilot areas. Since 2004, they have been implemented nationally. In 2014, the total area of receiving support was 355,693 ha (36.5% of the UAA). (MOA, 2015a; MOA, 2015b), and the number of farmers getting the EFM support was 1,487. (ARC, 2016; ARIB). Payments for theconversion toorganic farming are paid to applicants, who have not requested organic production support in the ERDP 2007-2013 or 2014-2020 programming period. Payment rates are described in Table 6.4 (ARIB, 2016c).

**Table 6.4. Payment rates for organic farms**

|  |  |  |
| --- | --- | --- |
|  | Rate for conversion to organic farming | Rate for maintenance of organic farming |
| Area of grasslands (except when the grassland is used as up to 2-year cover crop and for field inspected grass seed production) if at least 0,2 LU of organically kept bovine, equine, sheep, goats or bee swarms per hectare are kept, | 27 euros/ha | 25 euros/ha |
| Grasslands, if used as cover crop of 2 years | 88 euros/ha | 80 euros/ha |
| Cereals, legumes, oil and fibre crops, other technical crops, field inspected hay seed crops | 138 euros/ha | 125 euros/ha |
| If at least five hives were kept organically in the year preceding the submission of the support application. | 44 euros per bee colony | 40 euros per bee colony |
| Areas sown under certified organic cereal | 166 euros/ha | 150 euros/ha |
| Area of intertillage crops | 231 euros/ha | 210 euros/ha |
| Area under certified organic potatoes | 277 euros/ha | 252 euros/ha |
| Area under fruit and berry crops (except strawberry) | 330 euros/ha | 300 euros/ha |
| Area under vegetables, strawberry, aromatic and medicinal herbs | 660 euros/ha | 600 euros/ha |
| In case organic bovine, sheep, goats, swine, rabbits or fowl are kept, the cost per unit per one hectare of land is increased by the sum, which is obtained by multiplying the unit calculated on the basis of the average number of animals and fowl: the obtained amount is divided by the number of ha under grasslands cereals, legumes, oil and fibre crops and other technical crops, the support is applied for. | By 94 euros | By 85 euros |

1. The number of enterprises engaged in the organic production, and the area under organic farming in Estonia has increased in the recent years (see also Chapter 2). In 2005, there were 1,013 enterprises active in the organic production that had 59,742 ha of organic agricultural land at their disposal (ca. 59 ha per producer). By 2012, the number of enterprises engaged in organic production was 1,478 and the area under organic production amounted to 144,149 ha (ca 97.5 ha per producer). In 2015, these figures were 1,629 and 170,797 ha (ca 104 ha per producer), respectively. Organic farmland constituted 17% of Estonia's UAA. Organic land use in Estonia is characterized by a large share of grasslands (77% of organic agricultural land in 2015). In 2015, approximately 70% of organic farmers (1,151 out of 1,629) were engaged in organic livestock production. They raised sheep (54,470 animals), cattle (41,744 animals, of which 1,966 dairy cattle and 14,271 suckler cows of beef cattle), goats (1,566 animals), pigs (818 animals), poultry (33,977 birds, of which 23,036 laying hens), rabbits (2,639 animals) and bees (1,996 bee colonies). (MoRA, 2016; MoA, 2015a).
2. In 2014, there were 2,280 agricultural producers receiving ORG support. In 2015, there were 370 producers who got organic production support and 1,062 farmers who received support for conversion toorganic farming and support for maintenance of organic farming. (ARIB) Despite a decrease in the number of beneficiaries receiving ORG support in 2015, the number of bovine, equine, swine and rabbits from converted farms entered in the Organic Farming Register has increased, and that of poultry decreased as compared to 2014. Also, the area of total converted arable land decreased, although the area under legumes, potatoes and field vegetables has increased. The area of fruit orchards and berry gardens, permanent grasslands for growing grass, and grazed non-agricultural land has also expanded. (AB, 2016) The number of agricultural enterprises engaged in organic farming was 1,629 in 2015, which exceeded the 2014 level by 87, whereas 225 farms started the conversion and 139 were converted. Organic farms are growing increasingly larger, the average area of organic farmland in 2015 was 105 ha. Recent years have witnessed a rise in organic processing and marketing. At the end of 2015, there were 266 processors, packers, distributors and storers in the Organic Farming Register, which was 46 more than in 2014. (MRA, 2016) FADN data show that, as expressed in euros, organic crop production increased in 2010-14, whereas organic livestock production remained rather stable. Although the productivity of organic farming has improved over the past five years, livestock production in euro per livestock unit has reduced. (FADN, 2016) Strict rules are imposed on crop and livestock production, processing, catering and marketing in organic agriculture. Organic farming is regulated by the EU Organic Farming Regulation (EC) No 834/2007 and the Estonian Organic Farming Act. (MoA. Organic farming.)

### The degree of stringency of the environmental policies

### Basis for determining environmental payment rates

### Characteristics of policies for adaptation of agriculture to climate change

## Trade-related measures

*Trade measures that restrict market access for foreign inputs and commodities, and subsidise commodity exports restrict foreign competition and affect domestic market. They contribute to maintaining domestic price support and to hindering access to agricultural inputs and services or raising their costs. They may restrict access to innovative technologies and inputs.*

### Extent to which obstacles to trade affect the agri-food sector; limiting foreign competition by tariff and non-tariff market access barriers; contribution of existing tariff and non-tariff barriers to trade to hindering access to agricultural inputs and services or raising their costs

### Activities to reduce trade-related obstacles to innovation

## Agricultural support level and composition

*Changes in support levels and composition provide an overall picture of developments in incentives and disincentives from agricultural support policies to productivity growth, sustainably.*

### Extent to which agricultural policies are supportive of productivity growth, sustainably

1. In transition countries, agricultural producers often face budget constraints that hinder the investment for modernization of the production. In these conditions, the governments apply policies that facilitate farm investments. In Estonia, agricultural, land and ownership reforms were carried out in the beginning of 1990-s. At the same time liberal trade policy with 0 tariffs was applied. This opened Estonian market for cheap imports (subsidised exports) and lead to low farmgate prices and negative PSE for a short period (Viira, 2014). For agricultural producers it was difficult and expensive for to get credit in the 1990-s. Therefore, the 1990-s were characterised by lack of investments in the agricultural sector. Direct payments were first implemented in 1998, capital (credit) subsidies in the end of 1990-s.
2. Therefore, to compensate for the „lost decade in agricultural investments“, agricultural policy in Estonia has paid significant attention to supporting investments into modernisation of agricultural holdings. EU pre-accession programme SAPARD was launched in 2001, also RDP-s 2004-2006, 2007-2013, 2014-2020 include significant amount of investment support to agicultural producers for modernisation of their technologies. From Figure 6.2 it appears that (according to the classification of the economic accounts of agriculture (EAA)) investment grants, subsidies on products and other subsidies have significantly affected investments (gross and net capital formation) into agricultural holdings. As discussed in Chapter 2, the agricultural production indices have significantly increased since the beginning of 2000-s, suggesting that the policy decisions and farm investments have markedly affected the production and (partial) productivity development.

**Figure 6.2. Investments, subsidies and credits in Estonian agriculture, 1995-2015**

Source: EAA, Statistics Estonia (2016); Bank of Estonia (2016)

# 7. The agricultural innovation system

## General innovation profile

1. In most of the categories of comparative performance of national science and innovation systems (Figure 7.1), Estonia is in the middle range of OECD values. Estonia scores above OECD median in category of universities and public research. The index of public R&D expenditure was 44% higher than OECD median, and the index of publications in the top journals was 22% above the OECD median. Only in the subcategory of Top 500 universities, Estonia scored zero. The lack of Top 500 universities in Estonia partly stems from the fact that Estonian universities are relatively small compared to Top 500 universities.
2. In the category R&D and innovation in firms, Estonia reaches OECD median (exceeds by 2%) only in business R&D expenditure. As is the case with the universities, Estonia did not have Top 500 corporate R&D investors in 2014. In the subcategory triadic patent families, Estonia scored 60% below the OECD median, and in trademarks 26% below the OECD median.
3. In the innovative entrepreneurship category, the data about young patenting firms was unavailable. In the subcategories venture capital and ease of entrepreneurship index, Estonia scored 4% and 23% above the OECD median respectively.
4. In the category ICT and internet infrastructure, Estonia’s fixed broadband sunscriptions, and e-govenrment development scored closed to OECD median (88% and 100%, respectively). In wireless broadband subscriptions, Estonia scored 35% above OECD median. Information about ICT investments was unavailable.
5. In the category networks, clusters and transfers Estonia scored below OECD median (by 38%) in industry financed public R&D expenditure. However, in international co-autorhsip Estonia scored 18% above OECD median. In international co-invention, Estonia belonged to Top 5 OECD countries (71% above OECD median). Information about patents filed by universities and public labs was unavailable.
6. In most of the subcategories of skills for innovation, Estonia scored close to the OECD median. The index of tertiary education expenditure was 19% above the OECD median, the index of adult population at tertiary education level was 11% above OECD median. Nevertheless, the index of top adult performers in technology problem solving was 12% below the OECD mean. The index of 15 year-old performers in science exceeded the OECD mediab by 45%. The index of doctoral graduate rate in science and engineering was 10% below the OECD median.
7. Thus, one can say that Estonia has strongest competences and capacity to innovate in R&D, entrepreneurship environment, international cooperation and young performers in science. Shortcomings are mainly related to low RDI performance in firms, which, in part is due to the relatively small size of Estonian companies. While the public R&D expenditure is relatively high, the index of publications in the top journals is relatively high, and the index of top 15 year-old performers in science is high, Estonia has problems with doctoral graduate rate in science and engineering, and top adult performers in technology problem solving. This indicates shortcomings in knowledge transfer from high level R&D groups to the education system.

**Figure 7.1. Comparative performance of national science and innovation systems, 2014. Normalised index of performance relative to the median values in the OECD area (Index median = 100)**

Source: OECD

1. The results of the Eurostat Community Innovation Survey give a good overview of innovation implementation in food industry[[9]](#footnote-10). Figure 7.2 presents the innovation activities in the Estonian food industry in the period 2010-2012. Half of the companies have upgraded their equipment and machinery. External knowledge and R&D, as well as training for innovative activities were ordered less frequently. Figure 7.3 depicts the intensity of collaboration of food processors[[10]](#footnote-11) with different types of partners in product and process innovation. Enterprises cooperate mainly with equipment, materials, components, and software vendors (nearly half of the cooperating companies), but significantly less with the public sector (10% of companies), consultants and commercial laboratories (15%) and universities and other institutions of higher education (15%).

Figure 7.2. Share of food and drink enterprises engaged in innovation activities, by type of activity

Source: Statistics Estonia, 2015c. Calculations Estonian University of Life Sciences.

Figure 7.3. Share of enterprises that collaborate in product and process innovation with other companies or organisations, by origin

Source: Statistics Estonia. 2015. Calculations Estonian University of Life Sciences.

## Actors, institutions and governance

*The economy-wide environment for science, technology, and innovation determines the underlying incentives and dis-incentives in all sectors. Agricultural innovation systems (AIS) are increasingly driven in particular by economy-wide process and organizational innovations, new developments in ICT, and the bio-economy. A well-functioning AIS can help ensure good use of public funds, improved collaboration between public and private participants, including across national borders, and a more demand driven system that is responsive to the needs of ‘innovation consumers’.*

### Nature and scope of innovation policy across the economy

1. Formulation and implementation of innovation policy in Estonia is characterized by liberal economic principles in which the state intervention is moderate. For a long time, Estonian innovation policy has been built on innovation systems approach[[11]](#footnote-12). Supporting the economic sectors the state is specializing in forms an important part of the innovation system. As to investments into research and development (R&D) activities, focus is placed on promising areas of particular interest to the state guaranteeing high added value (Kalvet et al., 2010). The state has promoted information and communication technologies (ICT) the most by introducing a number of e-services (Romanainen et al., 2014).
2. National and sectoral development plans and strategies are related to the EU-wide strategies. Figure 7.4 depicts the framework of innovation, agriculture, food and sustainability related programmes and strategies. Two national horizontal strategies cover innovation, entrepreneurship and sustainable development concerns – the Estonian National Strategy on Sustainable Development “Sustainable Estonia 21”, and the National Reform Programme “Estonia 2020”. Most of the sectoral and sub-sectoral strategies are based on or related to two strategies – The Estonian Research and Development and Innovation Strategy 2014-2020 “Knowledge-based Estonia” and the Estonian Entrepreneurship Growth Strategy 2020. Three of the latter strategies are closely related to the pan-European growth strategy Europe 2020 contributing to achieving the strategic objectives set by the EU.
3. Sustainable Estonia 21, completed in 2005 and compiled under the guidance of the Ministry of Environment (MOE), is the most general overarching guidance document. This strategy, which aims are an increase in the welfare of Estonian population, cohesive society and ecological balance, devises the development of the Estonian state and society as a whole until 2030, and does not delve into any of the specific problems. The strategy covers many areas under the responsibility of different ministries. The implementation of the strategy is monitored on the basis of sustainable development indicators presented in the reports prepared every two years (Linnas, 2007).
4. Estonia 2020 describes the objectives and activities needed to to improve competitiveness. The two central objectives are increasing the productivity and employment. The intermediate objectives are set for 2015 and final objectives for 2020. While preparing Estonia 2020, the objectives and priority actions agreed between the EU heads of governments as well as European Commission (EC) recommendations to Estonia were taken into account. The development plan serves as an important basis for targeting national investments as well as the use of EU funds in Estonia (Government Office, 2014).
5. In order to increase the importance of the entrepreneurship and innovation policies, a reform of economic development policies was started in 2012. In compliance with the EU’s Smart Specialisation Platform, it focused on the policy management in growth areas and value chains with greatest growth potential. Priority growth areas are: 1) ICT, horizontally through all sectors; 2) health technologies and services, and; 3) more efficient use of resources. Within these areas, the following key segments are identified: programming, telecommunications, electronics, logistics, valorisation of wood, machine building and food industry. These value chains were selected on the basis of their role and development potential (in terms of value added, export volume and intensity, and number of employees) in Estonian economy in the period of 2014-2020, as well as on the developments in Europe and in the world (EDF, 2013; Kaarna et al., 2015).

**Figure 7.4. Framework of EU, national and sectoral innovation, agriculture, food and sustainability related development plans and strategies.**

Europe 2020 – Europe’s growth strategy

Horizon 2020 – The EU Framework Programme for Research and Innovation

EU-wide strategies and programmes

Estonian Entrepreneurship Growth Strategy 2014-2020

Estonian National Strategy on Sustainable Development “Sustainable Estonia 21”

National Reform Programme “Estonia 2020”

National

horizontal

strategies

Estonian Research, Development and Innovation Strategy 2014-2020 “Knowledge-based Estonia”

Digital Agenda 2020 for Estonia

Estonian Lifelong Learning Strategy 2020

Sectoral and sub-sectoral strategies related to innovation, productivity, agriculture, food industry and sustainability

Estonian Rural Development Plan for 2014-2020

National Tourism Development Plan 2014-2020

Estonian Regional Development Strategy 2014-2020

National Spatial Plan "Estonia 2030+"

Estonian Renewable Energy Action Plan for 2020

Raising incomes and promoting entrepreneurship

Education and science policy

Rural life

Environmental strategy 2030

Estonian Forestry Strategy until 2020

Environment, energetics

Developing peripheries, state reform

Policy areas

Smart Specialisation Platform

Source: compiled by authors on the basis of Christensen et al. (2012) and Government (2016)

1. Estonian Entrepreneurship Growth Strategy for 2014-2020 is the follow-up of the Estonian Enterprise Policy Strategy 2007-2013. Innovation wise the Estonian Entrepreneurship Growth Strategy for 2014-2020 is closely linked to the Knowledge-based Estonia. The general goal of the Estonian Entrepreneurship Growth Strategy for 2014-2020 is to facilitate the achievement of the umbrella objectives within the Estonia 2020, thereby contributing directly to attaining the goal ‘Growth of welfare’ in the Sustainable Estonia 21 (MEAC, 2013).
2. The main strategy document guiding the development of Estonia’s research, development and innovation (RDI) policy is Knowledge-based Estonia. The Ministry of Education and Research (MER), and the Ministry of Economic Affairs and Communications (MEAC) started compilation of the strategy in 2012. It is the third consecutive strategic document in this area. The overall aim of the RDI development is to create favourable conditions for an increase in productivity and living standard, for good-quality education and culture, and for the longevity and development of Estonia (MER, 2014). This strategy is closely related to the Estonian Entrepreneurship Growth Strategy for 2014-2020. The underlying principle in the division of labour in RDI between the MEAC and the MER is that the MEAC is responsible for offering support to innovation, including product and service innovation and capital inflow to enterprises. The management of international cooperation in R&D, guaranteeing a high level in R&D activities and supporting universities, and public research institutions is the task of MER. Both ministries are accountable for supporting cooperation between enterprises and research institutions in accordance to the division above.
3. The Estonian Lifelong Learning Strategy 2020 is a document that guides the most important developments in the area of education. It is the basis for governmental decisions for educational funding for the years 2014-2020, and for the development of programmes that support the achievement of changes necessary for moving towards a knowledge- and innovation-based society. The goals and measures of the Lifelong Learning Strategy 2020 are concordant with Estonia 2020 and Sustainable Estonia 21 (MER, 2014b).
4. The development of the Estonian information society strategy Digital Agenda 2020 was based on the understanding that ICT can be an important tool for achieving economic growth and improved quality of life. The Digital Agenda 2020 focuses on the creation of general preconditions for the development of the information society and the use of ICT. It does not deal with the introduction of ICT in different areas of life and policy. The sole exception is improving governance through ICT. Two strategic objectives laid down in Estonia 2020 – to increase productivity and employment through higher value added products and services – served as the starting point. In addition to Estonia 2020, the purpose of elaborating the strategy was also to find how to best meet the national socio-economic development challenges set in Sustainable Estonia 21 by the smart use of ICT. The development plan is thus a broader vision of the information society, which forms a basis for the various overarching national development plans and sectoral development strategies within the ICT sector (MEAC, 2013b).
5. National Renewable Energy Action Plan 2020 (NREAP) is based on the European energy policy aimed at combating climate change and boost the EU energy security and competitiveness. The aim of the NREAP is to ensure that the share of energy production from renewable sources in gross final consumption of energy would constitute 25% in 2020 (MEAC, 2010).
6. Estonian Forestry Strategy until 2020 is based on the sustainable forest management concept adopted at the Ministerial Conference on the Protection of Forests in Europe, which defines the stewardship and use of forest lands in such a way and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national and global levels without causing damage to other ecosystems (MOE, 2010).
7. The Estonian Regional Development Strategy 2014-2020 aims to harmonize the Estonian regional development based on increasing the competitive strength of Estonia as a whole, where good jobs, high-quality services, opportunities for advancement, empowerment and diversified activity would be brought to the communities and the unique features of the regions are preserved (MOI, 2014).
8. The National Spatial Plan “Estonia 2030+” aims to ensure economic competitiveness and human-friendly living environment through nature closeness and well-developed settlement network (MOI, 2013).
9. In addition to its own resources, Estonia is using EU structural funds to facilitate economic development, thus the investments are related to the long-term objectives of the EU. Estonia’s third programming period (2014-2020) during its EU membership is characterized by the introduction of new innovation policy instruments. In this period, the EU is focusing on the implementation of its smart specialization platform. In the period 2014-2020, Estonia will be allocated support from five EU structural and investment funds: 1) the European Regional Development Fund (ERDF); 2), the European Social Fund (ESF); 3) the Cohesion Fund (CF); 4), the European Agriculture Rural Development Fund (EAFRD); and 5) The European Maritime and Fisheries Fund (EMFF), which, in line with the Europe 2020 strategy, support economic development in all EU countries. The use of these funds is based on the partnership agreement between Estonia and the EC, which lists the agreed funding priorities, objectives and expected results, preconditions for financing and the general arrangement for funds administration, which forms a basis for the Cohesion Policy Funds Operational Programme 2014-2020 (MOF, 2014). In the previous programming periods, the priorities and measures were related to the renewal of infrastructure, but in this period, the EU and Estonian priorities and measures are aimed at economic growth, increasing people’s well-being, as well as the quality of work and life, which is closely related to innovation in products, services, processes and organizations (EUSAE, 2015).
10. During the planning for the EU programming period 2014-2020 (since 2012) the results of the implementation of the policies of the previous two periods were taken into account. The analysis of the experience so far gave rise to changes in the planned innovation policy renewal. First, this found expression in the proactive involvement of ministries, including the Ministry of Rural Affairs (MRA), in providing substantive input to RDI policy pursuant to their priorities and needs. The ministries were given greater responsibility in development of networks supporting policy-making in their sectors. By arranging sectoral debates social partners were better involved in the process of developing sectoral programmes and measures(MOF, 2014b).
11. Estonian innovation policy is followed in all policy areas, including agriculture and food industry. The innovation policy is implemented by the ministries and other agencies involved that follow the wide political agreements and priorities in the field of innovation, and contribute to innovation largely through achieving the agreed objectives. State-wide economic objectives, in turn, contribute to reaching the European-wide economic objectives. Sectoral development plans are usually prepared for seven years. Sectoral strategies are in line with the country’s budgeting strategy, which is drawn up for four years and updated annually. This way, the medium-term plans are constantly adapted in response to the changes in economy, fiscal and sectoral environment (MOF, 2015).
12. From 2004, when Estonia joined the EU, a significant part of the EU Structural Funds has been invested into the development of R&D infrastructure, human capital and entrepreneurship (MER, 2014). Activities that call for further development include the implementation of horizontal innovation policy in the country as a whole, the management of risks relating to the implementation or purchase of innovation, the co-operation between various parties, including the meaningful involvement of stakeholders. Although stakeholder involvement in the design and implementation of innovation policy in Estonia has gained momentum, their involvement today is still mostly restricted to participation in discussions with sectoral umbrella organizations and universities. The fact that Estonian innovation policy, both today and in previous programming periods, can be characterised by an abundance of policy documents, strategies, action plans, programmess and projects, which inter-connectedness is difficult to identify, may also be considered a problem (Romanainen et al. 2014).
13. The studies into the implementation of the innovation policy to date (Annexes I and II) indicate that there are comparatively asymmetric and fragmented RDI networks in Estonia that do not facilitate cooperation between the various parties, as well as holistic management of innovation ecosystem. So far, the implementation of the RDI policy at the measures, regulations, indicators level has been based on the linear understanding that innovation begins with basic research, which is followed by applied research and by the implementation of the new practical solutions in industry and economy. The persistence of this linear approach in Estonia can be explained by the relatively limited understanding of the role of the state in science and innovation, which finds expression in low-intervention and high-tech centred RDI policy affecting mainly the framework conditions for the economic environment, and where general statistics (e.g. number of publications, added value per employee, etc.) on the developments in the research systems, and corporate financial indicators have been applied as the main feedback mechanisms of innovation policies (Karo et al., 2014b; 2014c).
14. Unlike many other countries with high level of innovation that implement objective based innovation policies, accompanied by clear prioritization, selectivity mechanisms and effective cooperation between the stakeholders in developing the innovation policy, Estonian innovation policy is characterized by resource-based management, which primarily focuses on how to use the existing and new purchased resources to achieve a lasting competitive advantage. Like in many other countries demand side innovation[[12]](#footnote-13) has attracted more attention in Estonia in recent years, and that mainly for two reasons. First, it has been understood that only supply-based measures fail to guarantee the expected results in the promotion of innovation and economic growth in general. Second, the country must find new and more effective ways to continue to elaborate on the existing innovation policy measures in the limited budgetary conditions. Public procurement has so far been the most frequently used demand side tool with the highest impact (Romanainen et al. 2014).
15. When assessing the effectiveness of the innovation policy so far, it can be said that R&D activities in Estonia have perked up over the past decade, which has boosted productivity growth. The aspect calling for development is the cooperation in R&D between enterprises and universities, especially in the light of demand-driven innovation policy development. Overall, enterprises in Estonia can be regarded as innovative. This is reflected in their willingness to experiment with new products, services and solutions, and introduce innovative products. It is necessary to develop communication between the public sector (as to long-term strategic plans) and the private sector (as to innovation capacity). Estonian enterprises need a new qualitative leap in the highly competitive and global production and innovation networks. This requires enterprises to have greater capacity and skills to make progress in value chains (MER, 2014).

### Reaction of society to ever more rapid developments in science and technology

1. The Eurobarometer 2015 survey shows that, compared to the EU average, Estonians consider innovation as a positive phenomenon that provides a number of benefits, including the overall increase in the quality of life, environmental sustainability (e.g., introduction of electric cars), medical technology and the positive impact of pharmaceutical industry developments on medical services and drug efficacy, easier and faster access to the necessary information, e-services, including time-saving by means of digital signing and e-commerce, positive change in planning of working time and form (e.g., work from home, virtual meetings), etc. However, such developments also pose threats, including a decline in social skills, data security, privacy loss, manpower being replaced with machinery, etc. (Eurobarometer Qualitative Study, 2015).
2. The innovative character of Estonian organizations is close to the EU average, both in product and process innovation, as well as in organizational and marketing innovation (Statistics Estonia, 2015b). As to agriculture, in 2009-2013 most of the applications for innovation (investment) support asked financing for the purchase of modern equipment, whereas in food production and forest enterprises support was predominantly requested for new product development (EMU, 2015). The results of the survey "Innovation in Estonian enterprises and innovation support schemes" conducted under the aegis of MEAC showed that the added value created by low-tech enterprise sector has so far been higher than that of the high-tech enterprises. Based on the data of the first three quarters of 2015, beverage production ranked among the first in producing the highest added value per employee. The added value per employee in timber industry was almost one and a half times higher than the corresponding figure for furniture industry. Some very complex products are produced in Estonia, but units responsible for their technological solutions, marketing and sales are located elsewhere. Timber industry, on the other hand, is dominated by a number of companies based on national capital that control the entire value chain and, therefore, the added value remaining in Estonia is higher. There are a number of very successful and innovative enterprises in Estonia (for example, Estonia is the biggest exporter of wooden houses, and Europe’s largest wood pellet producer is located in Estonia), but their impact on Estonian economy as a whole has so far been modest (Kaarna et al., 2015).
3. As to the food products, research into the purchasing patterns of Estonian consumers carried out in 2014 showed that the main factors influencing consumers when buying food is its freshness and taste. The factors having the smallest impact on purchasing decisions, however, were the length of shelf life and the speed and ease of preparation. When making a purchasing decision, approximately a quarter of the respondents did not place any importance on the appearance of the package or on the agricultural production practices (e.g., whether fertilisers were used or not, etc.). However, the consumers attached importance to the country of origin, with preference for local products. The reasons highlighted were the quality and reliability of domestic production. As to imported products, mainly alcoholic beverages, cooking oil, pasta and fruit were bought. The preference for domestic production was expressed in case of potatoes, meat and dairy products. Only about 25% of consumers participating in the aforementioned survey indicated that their choices were not affected by the product prices, which means that although the updated product may be useful and desirable to the consumer, the food purchasing decision will still depend on price comparisons with other similar products (TNS Emor, 2015).

### Government’s communication with citizens on science

1. The period 2007-2012 can be regarded as the time of searching in the popularisation of science, which was devoted to testing and developing various activities. Less importance was assigned to the results of these activities. Various projects were supported that the organizers and advisors considered relevant. In this period, the state did not offer a clearer strategic approach (Kirss et al., 2013).
2. In order to achieve the main objectives (increase in employment, productivity, and exports, production of high value-added products, provision of innovative services, extensive use of ICT, high-level R&D activities) set in Estonia 2020, the Estonian Entrepreneurship Growth Strategy for 2014-2020, the Digital Agenda 2020, Knowledge-based Estonia, and the Estonian Lifelong Learning Strategy 2020, the Research and Technology Pact was signed in 2015 between the state, municipalities, business, education and the third sector, to provide joint support to the fields of science, technology and engineering. One of the aims of the Pact is to popularise science, technology and engineering in the society. To popularise research, research competitions for schoolchildren and students are carried out under the leadership of the Estonian Research Council (ERC). As of 2006, Estonia acknowledges remarkable individuals and bodies with the national science communication award to value science communication. ERC also organizes annual research conferences, which primarily target students in general education (ERC, 2015a).
3. TeaMe+ is an ERDF financed programme for popularizing science, technology, engineering and math (STEM) education fields, which has been dealing with popularizing science since 2009. This program is, inter alia, aimed at introducing scientific topics in the mass media, developing science journalism and promoting an open dialogue between scientists and society. The program has supported the public broadcast of two science programmes. “At the Top of the Pyramid” (Püramiidi tipus) aimed at the public, and adventurous science gameshow “Rocket 69” (Rakett 69) for the young. The latter was selected by the European Broadcasting Union as the best educational programme of 2012 (ERC, 2015b).
4. Initiated by Enterprise Estonia (EE), the largest competition of business ideas called *Ajujaht* (Brain Hunt) has been organised since 2007. Several times, the winners of the event have come from the primary sector related ideas (including a sensor-backed fish farming system, an automatic irrigation system for household plants, a web environment that allows people not having a household plot to purchase horticultural produce, a sensing device that makes it possible to measure the number and diameter of logs accurately and quickly, etc.). The competition is mainly targeted at professionals who crave for a career change, and students who want to create startups (Ajujaht, 2016).
5. Since 2006, a more targeted approach to introducing and promoting Estonian food at the national level has been taken. The plan for introducing and promoting Estonian food titled “Estonian food 2015-2020” focuses on building up a favourable reputation for Estonian food, enhancing cooperation and relationships between the different players in food supply chain and promoting export. The measures ordained in this plan are mainly related to supporting developments in production and processing, i.e. attention is concentrated on increasing efficiency and boosting value-added, expanding export and introducing research and development activities (MRA, 2015c).
6. The universities also support the popularization of science. E.g., the Estonian University of Life Sciences (EMU) organizes applied science prize competitions designed to encourage scientists and working groups to find effective ways of cooperation with the end-users of research results, to introduce innovative ideas into practice, and contribute to an increase in the applied research capacity and volume of external financing at the University (EMU, 2013). The University of Tartu (UT) is engaged in popularizing science among the people of different ages interested in the research. The activities of the UT Sciences School are targeted at young people in particular, and in cooperation with the Estonian Physical Society, the University launched science bus, where schoolchildren with a deeper interest in science have the opportunity to broaden and extend their knowledge. To introduce science to a wider public the UT cooperates with the Science Centre AHHAA and administers the science news portal ‘Novaator’ (UT, 2015).
7. In this budgetary period, the Horizon 2020 pays more attention to social problems that affect people’s lives, such as improving health services, environment-friendly transport, and food and energy security. The Horizon 2020 has a separate activity ‘Science with and for society’, which focuses on the integration of scientific and technological achievements into the society. In addition, Horizon 2020 introduces the endeavours in research and technology among young people (Horizon 2020).

### Integration of agriculture into the general innovation system

1. Innovation policy in agriculture is in line with the general innovation policy in Estonia, which is shaped by the state, and which leading promoters are MER and MEAC. As compared to the previous periods, the agricultural sector, as well as other sectors, has been more involved in the overall planning of the innovation system under the EU programming period 2014-2020. Sectoral strategies must support the strategic objectives set in Sustainable Estonia 21 and Estonia 2020 (Figure 7.4). The strategic objectives in the national horizontal strategies have been devised in cooperation with sectoral ministries, so that the sectoral policies and goals are reasoned and consistent with the objectives set. Therefore, ERDP for 2014-2020 is regarded as one of the sectoral strategies contributing to general innovation system of Estonia.
2. In the Partnership Agreement for Estonia, 2014-2020, the EU and Estonia have agreed upon 11 thematic objectives (Figure 7.5). Through its six priorities, ERDP 2014-2020 contributes to eight of these thematic objectives. MRA was involved in preparations of the Partnership Agreement.
3. The activities of MRA aim to create conditions for the sustainable and diversified development of Estonian rural life, agriculture and fisheries, ensuring safe and proper food and feed, and guaranteeing good standards in animal health, animal production and welfare, as well as in plant health and protection. To this end, the MRA works out sector-specific policies, legislation and standards, organize their implementation and the evaluation of their results. The most important agricultural and food related R&D programmes are Estonia’s Agriculture, Food and Fisheries Science and Knowledge Transfer Development Plan for the Period 2015-2021, The Programme of an Applied Research and Development in the Agriculture for 2015-2021, National Plant Breeding Programme 2009-2019, and Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014-2020. The relations of these programmes with associated EU and nation-wide strategies as well as agricultural and food sector strategies are depicted in Figure 7.6.
4. The implementation of the ERDP 2014-2020 contributes to achieving the objectives of Sustainable Estonia 21 (increase in the welfare of the Estonian population, cohesive society and ecological balance) through measures targeted at the competitiveness of agriculture and through environmental subsidies. ERDP 2014-2020 contributes to achieving the objectives (raising the employment rate of the population and productivity per employee, ensuring that the growth in labour cost would not exceed productivity growth, increasing the share of Estonian export in world trade, raising the level of investments into R&D, limiting GHG emissions, and increasing the share of renewable energy in final energy consumption) of Estonia 2020 through various investment subsidies, which aim to increase the competitiveness of enterprises (in agriculture, forestry, food industry and in other areas of rural entrepreneurship) and through various human resources development-oriented activities (training, advising). Green investments (including renewable energy) and environmental subsidies are also targeted at environment-friendly economy and energy. ERDP 2014-2020 also fosters the development of entrepreneurship in specific sectors (mainly agriculture, food and forestry sectors), focusing on solving specific bottlenecks in these areas, being directly in line with achieving the aims of Estonian Entrepreneurship Growth Strategy 2014-2020 (raising the productivity, increasing investments into R&D and stepping up exports). Through a variety of knowledge transfer activities focusing on fostering cooperation between entrepreneurs, researchers and advisors and the application of research results into practice, the ERDP 2014-2020 contributes to achieving the goals of Knowledge-based Estonia (increasing the impact of research systems in solving problems facing the Estonian society as well as improving the competitiveness of economy) (MRA, 2016b).

**Figure 7.5. Contribution of ERDP 2014-20 priorities to the EC-Estonia Partnership Agreement for the use of European Structural and Investment Funds for 2014-20**

Estonian Rural Development Plan for 2014-2020

Implementation Plan of Cohesion Policy Funds 2014-2020

The European Commission-Estonia Partnership Agreement for the use of European Structural and Investment Funds for 2014-2020

Thematic objectives:

|  |
| --- |
| 1. Strengthening research, technological development and innovation |
| 3. Enhancing the competitiveness of small and medium-sized enterprises, the agricultural sector and the fisheries and aquaculture sector |
| 4. Supporting the shift towards a low-carbon economy in all sectors |
| 5. Promoting climate change adaptation, risk prevention and management |
| 6. Protecting the environment and promoting resource efficiency |
| 8. Promoting employment and supporting labour mobility |
| 9. Promoting social inclusion and combating poverty |
| 10. Investing in education, skills and lifelong learning |

Priorities

|  |
| --- |
| 1. Enhancing knowledge transfer in agriculture, forestry and rural areas |
| 1. Improving viability and competitiveness of agricultural producers in all forms in all regions, and promotion of innovative agricultural technologies and sustainable management of forests |
| 1. Organization of food chain, including promotion of processing and marketing of agricultural products, animal welfare and risk management in agriculture |
| 1. Restoration, protection and improvement of agriculture- and forestry-related ecosystems |
| 1. Promotion of efficient use of natural resources, supporting the transition to low CO2 emissions, and climate change resilient economy in agricultural, food and forestry sectors |
| 1. Promotion of social inclusion, poverty reduction and economic growth in rural areas |

Source: compiled based on EC (2014).

1. Innovation is one of the priorities of the ERDP 2014-2020. The goal is expressed as follows: “Effective manufacturer, processor, and advisor collaboration with scientists, and transfer of up to date knowledge.” Focus is on encouraging collaboration between the various parties (producers, consultants, academics) and on thereby improving the adoption of research results into practice. The goal relates to the priority 1 of the programme – Improving knowledge transfer and innovation in the agricultural and forestry sector and rural areas. The measure ‘Cooperation’ supports the implementation of the action plans of agricultural innovation clusters. The measures ’Knowledge transfer and innovation’ and ‘Advisory support’ foresee a variety of incentives to ensure that RDI results would reach the producers. In these measures, the evaluation scale gives preference to the projects in line with the implementation of agricultural innovation clusters’ action plans and projects concerning the application of R&D results. One of the evaluation criteria in being granted ‘Advisory support’ is the training of advisers into the results of R&D. Investment support measures are contributing to innovation indirectly by supporting investments into various technologies, endowing thereby the introduction of innovations. Innovation also forms a key element in the LEADER local development measure. As a support unit, the Estonian National Rural Network (NRN) contributes to promoting innovation in agriculture. In order to achieve the aims, the NRN collects, aggregates and disseminates best practices, examples of innovative approaches and networking, provides help in partner search and participates in the work of the innovation networks (MRA, 2016b).

**Figure 7.6. Agricultural and food R&D programmes and associated horizontal and sub-sectoral strategies**

Europe 2020 – Europe’s growth strategy

Horizon 2020 – The EU Framework Programme for Research and Innovation

EU-wide strategies and programmes

National Reform Programme “Estonia 2020”

National horizontal and sectoral strategies

Estonian Research, Development and Innovation Strategy 2014-2020 “Knowledge-based Estonia”

Agricultural and food research and development programmes

Estonian Rural Development Plan for 2014-2020

The Programme of an Applied Research and Development in the Agriculture for 2015-2021

Estonia's Agriculture, Food and Fisheries Science and Knowledge Transfer Development Plan for the Period 2015-2021

National Plant Breeding Programme 2009-2019

Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014-2020

Associated agricultural and food sector strategies

Estonian Organic Farming Development Plan for 2014-2020

The Estonian Dairy Strategy 2012-2020

Estonian Seed Sector Development Plan for 2014-2020

Estonian Horticultural Sector Development Plan 2015-2020

Estonian Development Plan in the Cereals Sector for the Period 2014-2020

Estonian Agricultural and Rural Extension Services’ Development Plan for 2012-2020

Estonian Bioeconomy Strategy for 2030 (in preparation)

Development Plan of Governance Field of Estonian Ministry of Rural Affairs for 2016-2019

European Maritime and Fisheries Fund Operational Programme 2014-2020

Sustainable Use of Pesticides Agenda 2013-2017

Estonian Fisheries Strategy for 2014-2020

Estonian Aquaculture Strategy 2014-2020

[Plan for introducing and promoting Estonian food “Estonian Food 2015–2020”](http://www.agri.ee/et/eesti-toidu-tutvustamise-ja-muugiedenduse-kava-eesti-toit-2015-2020" \o "Lähemalt Eesti toidu tutvustamise ja müügiedenduse kavast)

National Strategy for School Fruit and Vegetable Scheme (since 2015)

Action plan: Climate Change Mitigationand *C*limate Change Adaptation *i*nAgricultural Sectorfor 2012 -2020

Estonian Beef Sector Development Plan 2015-2020

Source: compiled on the basis of MRA (2014b and 2016a)

1. Estonian farmers and industry are characterized by the lack of capacity to invest into R&D activities. Investments into R&D are risky and their payback period is long. The level of cooperation along the chain, between producers, as well as producers and processors is relatively weak. ERDP 2014-2020 and the measures in the sectoral development plans and agricultural applied research programme 2015-2021 have proposed specific activities and grants to increase the competitiveness of agricultural producers and processors (including knowledge transfer and dissemination, advisory services and co-operation). The ERDP for 2014-2020 puts a greater emphasis on RDI. The sub-measure ‘Research and development cooperation’ is intended to support individual projects, which promote cooperation and foster innovation, in agriculture, food and forestry sectors in particular, and solve the specific problems related to the production process of individual producers and processors.
2. However, agriculture may be considered the supply-side field, where more than half of the innovations that are adopted in Estonia and elsewhere in the world are made by the suppliers of equipment and materials. The demand-side involvement in R&D activities is modest and the number of patent applications is relatively small.

### Governance structure

1. Innovation management’s governance system in Estonia is depicted in the Figure 7.7. All ministries are responsible for the management of R&D activities and their funding in their field of governance. The ministries, inter alia, work out R&D programs, and organize their implementation. To this end, the MRA has drawn applied research programs since 2004 (MRA, 2016d).

**Figure 7.7. Overview of the Estonia’s research system’s governance structure**

Strategy Office of the State Chancellery

Research and Development Council

Government

Parliament

Ministry of Education and Research

Ministry of Economic Affairs and Communication

Ministry of Rural Affairs

Other sectoral ministries

Research Policy Committee

Archimedes Foundation

Estonian Research Council

Universities

University of Tartu

Tallinn University of Technology

Estonian University of Life Sciences

Estonian Academy of Sciences

Public Research Organizations

Innovation Policy Committee

Enterprise Estonia

KredEx

Council of Agricultural Sciences

Agricultural Registers and Information Board

Rural Development Foundation

Agricultural Research Centre

Estonian Crop Research Institute

State Research Organizations

Private Research Organizations

Estonian Development Fund

Source:Christensen et al. (2012), elaborated by authors

1. Until 15.03.2016 the Estonian Development Fund (EDF) was responsible for the monitoring and analysis of the growth areas, engaging entrepreneurs, researchers, and sectoral ministries, and, if necessary, other institutions or partners in the discussions on specific growth areas. Smart specialization areas were controlled by a Steering Committee comprising of the representatives from the MER, MEAC, Government Office, MOF and, if necessary, the representatives of other ministries and enterprises. The Steering Committee monitored the movement towards achieving the goals and fulfillment of the objectives and, when necessary, made proposals for changes in policies and activities, or initiated changes to the strategies (MEAC, 2013). To continue the monitoring activities performed by the EDF an independent unit with its own budget and competence for decisions will be set up under the Estonian Parliament, whereas the responsibility for EDF investment activities will be transferred to KredEx (Parliament of Estonia, 2016).
2. To implement Estonia 2020, MEAC devises an annual roadmap, which is approved by the Government. The roadmap includes the list of planned activities together with the indicators, budgets and responsible parties. With each new action plan, the report for the previous period is submitted to the Government. The bodies involved in the development and implementation of innovation and entrepreneurship policies have the following roles (MEAC, 2013):

* MEAC sets the strategic directions and formulates the application principles and distributes the roles between the implementing authorities.
* Innovation and Enterprise Policy Committee advises the Minister of Economic Affairs and Communications on key policy issues and assesses policy implementation.
* EDF organised the foresight activities necessary for long-term policy-making and made direct venture capital investments till the launch of the state venture capital fund, monitored and analysed international economic indexes and made policy suggestions on the basis thereof.
* KredEx supports business development through various financial instruments. KredEx portfolio includes loans, credit insurance and government-guaranteed securities. As a new direction KredEx will start to manage the venture capital fund.
* Enterprise Estonia (EE) helps to implement the innovation and entrepreneurship policy through various support schemes, counselling and training. In 2014-2020, the foundation puts more emphasis on the development of long-term partnerships with enterprises, and providing support through comprehensive development plans.

### The main actors and institutions in the AIS and their respective roles

1. The main actors of the Agricultural Innovation System (AIS) are (Figure 7.7):

* At the government level, MRA is responsible for AIS, as it governs the extension services and the above-mentioned R&D institutions, except the universities.
* R&D institutions in Estonian AIS: agricultural research is mainly carried out by EMU (animal husbandry, veterinary, agricultural economics, rural sociology, environment, plant sciences, food sciences), Estonian Crop Research Institute (ECRI), UT (environmental sciences) and (TUT) (biotechnology, food sciences).
* Higher education: mainly EMU.
* Vocational education: 9 vocational schools (*Järvamaa Vocational Education Centre, Olustvere School of Rural Economics and Service, Luua Forestry School,  Pärnumaa Vocational Education Centre, Hiiumaa Training Establishment, Räpina School of Horticulture, Väike-Maarja Vocational Education Centre, Viljandi Vocational Education Centre, Tartu Vocational Education Centre*)
* Rural Development Foundation (PDF) is responsible for the elaboration of the advisory system for Estonian agricultural and rural enterprises and guaranteeing them access to high-quality consulting services.
* The Rural Economy and Agricultural Advisory Service is a registered trademark belonging to the Rural Development Foundation (RDF), which offers advisory services in agriculture and rural economy and brings together advisers who pass on advice to farmers and rural entrepreneurs.
* Agricultural Research Centre (ARC). The main activities of the ARC are field tests and experiments, laboratory analyses, preparing liming and fertilizing maps, good agricultural practices and agro-chemistry research, evaluation of agri-environmental measures, horticultural testing activities, etc.
* Three museums as support systems. The main role of the museums is to deal with the issues of “new generation” – to promote agriculture and rural life.
* Estonian Agricultural Registers and Information Board (ARIB) is a paying agency administrating agricultural policy measures.
* Council of Agricultural Sciences has been convened to advise the Minister for Rural Affairs (MRA) on the issues of RDI under their authority, monitor the implementation of RDI measures funded by the MRA and on this basis propose the minister improvements.

1. Estonian enterprises are mostly small and they often lack resources for research-intensive studies. Therefore, in creating innovative solutions, in cooperation with enterprises in the specific field, universities and research institutes, competence centres were launched that are funded by EE. In 2014-2020, six state-supported competence centres will operate in Estonia, two of them in the field of food technology and one in biomedicine (EE, 2016). The objective of competence centres is, by integrating the knowledge and experience of enterprises and R&D institutions, to create new food- and feedstuffs with high export potential, to improve the quality, functionality and storage characteristics of food and to develop new technologies. One of the aims of applying the research in practice is to make the production and processing of raw material more efficient. To achieve this, R&D activities cover the whole food chain: from animal breeding, feeding and keeping to the creation of health promoting food products and conducting clinical and physiological trials to prove their health promoting qualities. (BioCC, 2016; TBP, 2015).
2. Up to 1994, agriculture research institutes were subject to the jurisdiction of the Ministry of Agriculture. In 1993, their integration into the universities began (ERDC, 1999). By 2001, five research institutes previously within the jurisdiction of MOA had been merged with the EMU. In 2003-06, faculties were restructured into institutes. At present (2016) there is only one research and development institute in area of governance of the MRA – Estonian Crop Research Institute (Table 7.1)

**Table 7.1. Merger of research institutes in the area of administration of the Ministry of Agriculture in 1993-2013**

|  |  |  |
| --- | --- | --- |
| Research institute | Year | Merger and other restructuration |
| Institute for Rural Development | 1993 | Merged with the Estonian Agricultural University |
| Estonian Research Institute of Animal Breeding and Veterinary Science (ELVI) | 1994 |
| Estonian Forest Research Institute | 1996 |
| Institute of Zoology and Botany, Institute of Experimental Biology, Estonian Plant Biotechnical Research Centre EVIKA | 1997 |
| Estonian Agrobiocentre | 2001 |
| Estonian Institute of Agrarian Economics | 2001 | joined to Jäneda Training and Advisory Centre |
| Estonian Institute of Agricultural Engineering | 2002 | joined to Estonian Research Institute of Agriculture |
| Jäneda Training and Advisory Centre | 2006 | renamed Rural Economy Research Centre |
| Jõgeva Plant Breeding Institute and Estonian Research Institute of Agriculture | 2013 | joined to Estonian Crop Research Institute |
| Estonian Crop Research Institute | 2016 | In the jurisdiction of the Ministry of Rural Affairs |

Source: compiled by the authors, based on ERDC, 1999; EMU, 2016c and MRA, 2005

1. The research carried out in the research institutes under the jurisdiction of the Ministry of Agriculture mentioned above was mainly applied research by nature (e.g. new varieties, biological medicinal products, technologies, etc.) (MRA, 1999). Based on the Organisation of Research and Development Act adopted by the government in 1997 the first national programme “Agricultural Applied Research and Development 2004–2008” was approved in 2004, which main aim was to contribute to raising the competitiveness of agricultural production and the processing of agricultural products, analysing the risks to the consumer and the environment arising from agricultural production of agricultural production, and developing solutions for minimizing those risks in the whole production and processing chain (MRA, 2016j). In 2016, it is already the third programme “Agricultural Applied Research and Development” (for the period 2015–2021) in effect in Estonia, which aims to provide the Ministry of Rural Affairs knowledge-based input to policy making, legislating and state supervision, as well as the coordination and financing of international research cooperation (MRA, 2016k). The activities carried out within the programme include conducting surveys and providing expert opinions, as well as the coordination and funding of international research cooperation projects. The programme aims to contribute to the objectives “Competent scientific support for designing and implementing CAP and fisheries policy” and “Estonian researchers take part in international research cooperation” of the Estonian Strategy for Research and Knowledge Transfer in Agriculture, Food and Fishery 2015-21 and the objectives of the Estonian Research and Development and Innovation Strategy 2014-20 “Knowledge-based Estonia”, including such sub-goals as “Research and development (RD) functions in the interests of the Estonian society and economy” and “Estonia is active and visible in international RDI cooperation”. (MRA, 2015)

### Establishment and communication of priorities

1. Setting priorities in development strategies in Estonia is based on the goals of the Europe 2020 strategy. Achieving the objectives of innovation strategies – ensuring the sustainable development of society through RDI – is supported by Sustainable Estonia 21 and Estonia 2020. Figure 7.8 describes the mechanism for the development of priority areas in agriculture.

**Figure 7.8. Mechanism for the development of priority areas**

Sectoral strategic objectives and priorities

Vertical activities

Ex-ante evaluation of development plans

Sectoral SWOT analyses

Results of various studies

Analysis of the results and experience from the previous programming periods

Proposals from sectoral representatives

Analyses of EU, national and sectoral strategic trends and developments

National strategic objectives

Analyses and ex-ante activities

Horizontal priorities

Recommendations of the EC

EU strategic objectives

Source: compilers of the report

1. The development plans are based on SWOT analyses, the analysis of the strategic documents of the EU, other countries and sectors, as well as of the results and experience from the previous periods is carried out. According to the Regulation of the European Parliament and of the Council of the European Agricultural Fund for Rural Development (EAFRD) ex-ante evaluation and SWOT analysis form a mandatory part of the development plan (Official Journal, 2014). The ex-ante evaluation of the ERDP is carried out by the procured enterprises, whereas the MRA and the permanent evaluators (from EMU and ARC) provide their input (MRA, 2016e).
2. During the ex-ante evaluation, the evaluators conduct interviews with the representatives of the organisations responsible for the implementation and consult with the representatives of the Government Office and ministries, in order to take into account the developments in national policies. E.g., when providing ex-ante evaluation on the ERDP 2014-2020, the experts suggested that a greater emphasis should be placed on the dissemination of information in the field of RDI, as well as on enhancing cooperation between the different parties, including farmers, entrepreneurs and advisory services. A significant threat to the sustainability of agriculture is the insufficient spread of RDI information, and the lack of cooperation between different stakeholders in promoting innovation. The evaluators also state that offering multi-disciplinary solutions to agricultural producers and processors has taken a secondary place, as a result of which the actors have not received sufficient information on the entire production chain (MRA, 2016e).
3. The communication strategy of the ERDP 2014-2020 describes the management of dissemination and publicity, which is being implemented on the basis of annual action plans. Communication management is coordinated by MRA. One of the sub-goals of the communication strategy is to communicate the priorities, objectives, activities and results of the ERDP to the target audience. It is the responsibility of MRA and ARIB, as the donors and holders of repository systems, to ensure public access to all relevant documents and inform the potential grant applicants and the public at large about the issues related to the implementation of innovation policy in a coordinated way and on a regular basis. Various social partners, primarily the different umbrella organizations (representing potential beneficiaries of third sector organizations), will be cooperated (Figure 7.9).

**Figure 7.9. Communicating strategic objectives and priorities to target groups**

Economic and social partners

Applicants and beneficiaries

Entrepreneurs, non-profit organisations, associations, foundations

Public at large

Support structures

Rural Economy Research Centre

National Rural Network

Innovation Network

Estonian Agricultural Registers and Information Board

Coordination of communication

(responsibility of Ministry of Rural Affairs)

Target audience

[Ministry of Rural Affairs](http://www.agri.ee/en)

Source: Compilers of the report

1. MRA is responsible for informing the public about the objectives of the EU CAP and its effects on Estonian agriculture and rural life. The overall presentation of grants concerning agriculture and the development of rural life, the publication of the objectives, priorities, measures and results of development plans and strategies, communication with the paying agencies about the rules of procedure, the rules related to publicity and good practice concerning the EAFRD support and the publication of the list of beneficiaries and the amounts of support are also the responsibility of MRA (MRA, 2015a).
2. ARIB as the paying agency is held responsible for informing the potential applicants about the eligibility conditions, for the production and dissemination of guidelines necessary for filling in the application forms and writing projects, for informing the grant applicants about the rules of procedure, for informing the beneficiaries about the rules related to publicity and good practice concerning the EAFRD support and the publication of the list of beneficiaries and the amounts of support.
3. Regional contact points of advisory service, NRN, innovation network, municipalities, Representation of the EC in Estonia, advisers and consultants, and the press that are also responsible for the dissemination of relevant and timely information to target groups constitute the support structures.
4. Target groups that the necessary information is communicated to are the public (indirect beneficiaries), applicants and recipients (potential beneficiaries), entrepreneurs, non-governmental organizations, foundations and their associations, local action groups and other economic and social partners.
5. The communication channels used comprise the MRA and ARIB web pages, print and electronic media, including regional newspapers and specialty publications, seminars and information sessions. Every year, MRA publishes a monitoring report on the preceding financial year that contains finance performance indicators and results. The Department of Research and Development of MRA is responsible for the outreach activities in relation to national information days and for the collaboration with advisors, counsellors and county advisory and information centres. Since 2014, a separate information letter covering innovation and the EIP themes is published.
6. The Rural Economy Research Centre (RERC) that performs the duties of national rural and innovation network unit also participates in the ERDP outreach activities and is involved in the dissemination of monitoring and evaluation results. RERC collects and disseminates information on the sector and in the EU Programming period 2014-2020 is responsible for networking within ERDP cooperation, as well as for collecting and disseminating the results from innovation (RERC, 2016). The rural and innovation network unit collects, analyses and disseminates information in its field of action and arranges events necessary to promote the activities of rural and innovation network.

### Identification of market and system failures

1. The identification and analysis of market failure related issues are addressed in the course of the ex-ante evaluation of ERDF measures. Ex-ante evaluation is based on the European Commission guidelines. A preliminary analysis of the implementation of financial instruments has been carried out in the course of ex-ante evaluation aimed at identifying the market failures and sub-optimal investment situations in the specific fields, assessing the need for public capital injections and defining their possible scope, together with any supporting financing instruments (e.g. equity investments, guarantees, loans). The results of the ex-ante evaluations have formed the basis for the elaboration of the financial instruments applied within the ERDP 2014-2020 and the European Maritime and Fisheries Fund Operational Programme 2014-2020. In the course of the evaluations, experts gathered input for mapping the market failures and their analysis through web surveys and telephone interviews with the enterprises. Secondary data have been derived from different surveys. Experts were found through the public procurement procedure from among the companies offering consulting and advising services (MRA, 2016l, MRA, 2016m).

Inclusion of environmental and sustainable natural resources concerns in the decision-making process regarding AIS priorities

1. Sustainable development is one of the key priorities both in the EU and the Baltic Sea region. Estonian national sustainable development principles and development targets to 2030 are set in Sustainable Estonia 21, which harmonizes the economic, social and environmental developments with the documents defining global (Agenda 21) and long-term development in the EU. The strategy aims to integrate the requirements arising from global competition with the principles of sustainable development and the preservation of the traditional values ​​of Estonia (State Journal, 2005).
2. In case of environment, the priority for Estonia is clean and diverse natural environment and the efficient use of natural resources. As to environment, the ERDP 2014-2020 ordains the environmentally friendly use of agricultural land, which gives due weight to regional specificities, guarantees the preservation of biodiversity, traditional landscapes and high nature value agriculture and forestry. The focus here is on the environmental measures that should result in the improved environmental impact of agriculture on water, soil and biodiversity. A variety of activities are planned for the preservation of high natural value agriculture and forestry. In addition, the competitiveness activities of the ERDP 2014-2020, which support different environmental and resource-efficient investments and innovation, also contribute to achieving the objective (MRA, 2016b).
3. The assessment of environmental impact, research, consultation and extension services as well as environmental analyses are performed by the Estonian Environmental Research Centre (EERC), which was founded in 1996. EERC is a company that belongs to the Republic of Estonia and reports to the MOE (Estonian Environmental Research Centre, 2016) and other companies and experts chosen by means of public procurement. The foundation Environmental Investment Centre (EIC) was founded in 2000 by the MOF. The EIC is responsible for maintaining the good environmental status, financing projects targeted at higher natural resources productivity and the prevention and remedying of environmental damage (Environmental Investment Centre, 2016). Survey reports are available on the public website of the MOE (MOE, 2016d).
4. Different investment subsidies concentrating on resource efficiency and giving preference to a variety of environmental and renewable energy investments, contribute to the alleviation of climate change. Environmental measures of the ERDP 2014-2020 related to health and quality of life issues are aimed at the reduction of the use of fertilizers and pesticides and guaranteeing healthier food to the consumers. Nature Conservation Development Plan 2020 is a strategic document for the development of areas related to the protection and use of nature up to the year 2020 (MRA, 2016b).
5. Environmental protection and technology R&D programme KESTA (20150-2015) constituted a cooperation programme between MER, the MOE, MEAC and MRA that focused on the RDI priority actions in the field of environmental protection and technology in Estonia. The programme was implemented through two sub-measures. The projects implemented in this programme addressed, e.g. applied research on ecosystem matter cycles and conditions of biodiversity, innovative environmental-technological solutions and risk analysis encompassing environmental hazards in Estonia. The operational programme was implemented by ERC (ERC, 2016). The programme was assessed in the course of interim assessment in 2012 with a view to contribute to the process of development and implementation of the next Structural Funds programming period (2014-2020), as well as arranging the final evaluation process.
6. Assessing the impact of environmental risk factors on health has been carried out through the ERDF health promotion research programme TerVE (Healthy), which in the period 2011-2015 was implemented the Archimedes Foundation. The sub-actions of the programme “Assessing the impact of environmental risk factors on health" included studies into health risks arising from the ambient environment, the elaboration of a long-term R&D development plan in environmental health and informing the public about the R&D activities in the public health sector (Health Promotion Research Programme TerVE, 2016). At present the TerVE programme is implemented by the ERC.

### Measurement and evaluation of performance

1. The priority of the Cohesion Policy Funds Operational Programme 2014-2020 “Stimulating business growth supported by R&D” is related to economic growth and RDI. Performance indicators include the share of private spending on R&D activities in the public sector, Estonia’s success rate in Horizon 2020, the scope of agreement of the obtained funding per capita, the share of R&D expenditure in the private sector (% of GDP), the share of enterprises cooperating for innovation with universities and other institutions of higher education as a percentage of total surveyed enterprises, and resource productivity attained through innovative solutions (MOF, 2014).
2. Programmes are evaluated to find out how effective one or the other action has been. To do this, data on the results and impact of the programmes, including the environment, agriculture and rural development as a whole, is collected and consistency with the set targets is assessed. As to the nature of their content, the evaluations are divided into evaluations of operational nature, focusing on the functioning of the system, and evaluations of strategic nature, focusing on the achievement of the objectives. Evaluation is carried out in three stages (MoF, 2014b):
3. Ex-ante evaluation (including the ex-ante evaluation of the EU and the European Cohesion Policy Funds operational programmes, as well as ex-ante evaluation of sectoral development plans).
4. Evaluations undertaken during the program period (typically carried out in two-year cycles, with the aim to assess the efficiency, effectiveness and impact of priority axes).
5. Ex-post evaluations (evaluations carried out after the end of the period. These evaluations are performed by the EC in cooperation with the Member States. Member States, including Estonia, can arrange additional needs based evaluations to identify the effects of subsidies).
6. The evaluation of the RDI system in Estonia as a whole was carried out in the years 2011-2015 in the framework of a special monitoring programme “TIPS” for research and innovation policies, launched specially by the MER, where evaluations were carried out by the researchers and scientists from UT and TUT. The studies conducted within the TIPS programme are listed in Annex 1.
7. Since 2002, a series of studies and surveys “Innovation Studies”, commissioned by the MEAC has been published. The series brings together studies, evaluations and analyses on the Estonian innovation system and innovation policy. The action is an attempt to raise awareness for innovation and promote knowledge-based innovation policy in Estonia. The studies and surveys published in the series “Innovation Studies” are listed in Annex 2.
8. Permanent evaluators participate in the evaluations, policy studies are conducted by Estonian and international bodies and the National Audit Office of Estonia also passes its judgement through audit.

### Levels (project, program, system) and frequency of performance evaluation

1. Estonia 2020 is reviewed annually and updated, if necessary. The upgrading process takes into account the statistics related to achieving the set objectives, the country-specific recommendations obtained during the European semester, discussions between ministries, strategy documentation on the use of support/investments for the EU budget period 2014-2020, as well as the priorities of the new government coalition and the challenges specified in the talks between the prime minister and ministers (Government Office, 2014).
2. Statistics Estonia, acting under the leadership of the MOF, monitors the implementation of Sustainable Estonia 21. Statistics Estonia collects and analyses the statistics on sustainable development and every two years publishes the results of the statistics in the publication “Sustainable Development Indicators” (Statistics Estonia, 2015a).
3. The implementation of the RDI policy is monitored on an annual basis. MER is responsible for the implementation of the programme and reports the monitoring results to the Government every year. The evaluation of the strategic objectives are based mainly on official and internationally comparable statistics (Eurostat, Statistics Estonia, European Innovation Union Scoreboard, Europe 2020 implementation surveys, databases of the OECD, the Estonian Education Information System EHIS; Scopus/Science Metrics, Thompson Reuters Web of Science, the Horizon 2020 database). All these sources are used to check whether the target levels of the indicators have been reached. In case of some indicators, where drawing comparisons is not possible, a methodology for benchmarking is developed. The monitored indicators include the share of private investment (% of GDP), productivity per worker as of the EU27 average (%), Estonia’s place in the Innovation Union Scoreboard, number of PhD defences in an academic year, the proportion of high-level Estonian scientific papers among the 10% of the world’s most cited articles, the number of high-level Estonian scientific articles per one million inhabitants, the share of private sector investments into the R&D expenditure of the public sector, the share of expenditure earmarked for socio-economic applications (except academic studies) from the state budget R&D allocations, the share of high-tech products and services in exports (%), the share of high and medium-high-tech sector employment as of total employment (%), Estonia’s success rate in obtaining funding from the Horizon 2020, including the volume of contracts per capita (% of the EU average), and the proportion of internationally coordinated research in state-funded R&D (MER, 2014).
4. In the middle of the programme period, an interim report on the implementation of the R&D strategy will be compiled under the leadership of MER. Interim evaluations are carried out by the respective specialized research institutions. Both quantitative (databases, statistics, reports, etc.) and qualitative (interviews, panel of experts, etc.) methods are used in the evaluation. At the end of the programming period, the success of the strategy as a whole, as well as the effectiveness of the measures and the capabilities of the participants are analysed, and recommendations for the next period are made.
5. Now the third RDI programming period (2014-2020) has started. At the end of the first period (2004-2006), the evaluators assessing the implementation of the strategy pointed out that the RDI system in Estonia was more public sector (financing) centred than in the EU countries on average, whereas the final report for the second period (2007-2013) stated that Estonia was moving towards enterprise and higher education institutions dominated model characteristic of the Nordic countries. A problematic aspect highlighted at the beginning of the third programming period was high dependence on the R&D activities of enterprises and higher education institutions on public funding, and the non-compliance of some indicators to peculiarities of Estonia (e.g., patents as too narrow an indicator, or Estonia’s place in the Innovation Union Scoreboard, which is measuring the R&D-based innovation, rather than the import of knowledge and its application for the benefit of the society, which is important from Estonia’s point of view (Ukrainski et al., 2015a).
6. In the framework of **Estonia 2020,** MEAC is responsible for implementation and monitoring of the entrepreneurship and innovation policy in Estonia. The entrepreneurship and innovation policy evaluation is designed to assess the impact, effectiveness and feasibility of the implemented measures. To implement the strategy, every year MEAC prepares an action plan (with the report on the previous action plan), which is approved by the Government. The action plan lists the planned activities together with the indicators, budgets and responsible parties. Mid-term evaluations take place every two years. Mid-term evaluations assess the impact of business supports and loans on enterprises. Enterprises that have used the respective services are compared against companies that have not used such services. The evaluators use both the corporate economic performance data, and interviews and surveys. Quantitative and qualitative combined research methods are used. Interim evaluations are commissioned and organized by the MEAC and conducted by MEAC in cooperation with EE and KredEx (Jaaksoo et al., 2012).
7. In addition, the EU carries out the Community Innovation Survey (CIS) with two years’ frequency. Estonia also participates in it. Establishments answer questions about product, processes, marketing and organizational innovation, as well as about the sources of innovation and cooperation and the distribution and volume of investments. Information on new product and non-domestic revenues is also collected. The aim of the CIS data analysis is to identify the barriers to the innovation process and find the biggest obstacles affecting the innovation system (Kaarna et al., 2015).
8. As to Smart Specialisation, monitoring activities were carried out by EDF. The intermediate and ex-post evaluations are arranged by RDC. These reports compare the obtained results against the set objectives as well as to the world-class achievements (MER, 2014).

### Criteria of performance measurement

1. Since 2006, a common pan-EU evaluation process, the Common Monitoring and Evaluation Framework (CMEF), is used to assess ERDP. The CMEF establishes agreed indicators for assessing the achievement of established results and impacts. In addition, the CMEF includes evaluation questions, which can be approached through additional national indicator analysis. In 2014 the common monitoring and evaluation system (CMES), which is a part of the CMEF was introduced.
2. The aim of the ongoing evaluation system is to monitor the results and impact of the ERDP. In the course of the ongoing evaluation, the assessors, among other things, perform sectoral studies and analyses, necessary for elaborating on the evaluation. ARC (agri-environmental measures) and the Department of Rural Economy Research of the Institute of Economic and Social Sciences of EMU (other rural development measures) are responsible for the ongoing evaluation. In cooperation, the ongoing evaluations aim at identifying and monitoring the results and impacts across the ERDP, including the impact of CAP I pillar measures on the ERDP, and vice versa, as well as assessing the impact of other horizontal issues (sustainable development, climate change and innovation) in the context of the ERDP and the contribution of the ERDP into the common strategic framework. The evaluators measure the output indicators once a year. The simplified version of the evaluation system applied to assess the ERDP in programming periods 2007-2013 and 2014-2020 is presented in the following table (Table 7.1).

**Table 7.1. The evaluation system applied to assess the ERDP in programming periods 2007-13 and 2014-20**

|  |  |  |
| --- | --- | --- |
|  | Evaluation frequency per programming period | |
| Type of evaluation | 2007-2013 | 2014-2020 |
| *ex ante* evaluation | 1 x | 1 x |
| ongoing evaluation | every year | every year |
| mid-term evaluation | 1 x | 2 x |
| *ex-post* evaluation | 1 x | 1 x |

Source: on the basis of Monitoring and Evaluation of the ERDP 2007-2013 (MRA. 2013b.) and Monitoring and Evaluation of the ERDP 2014-2020.

1. The evaluation (2014-20) is predominantly conducted along the priorities, measures, target areas and priorities of the projects. According to CMEF, output indicators are set on the measures level, result indicators on the target area level and impact indicators on the priorities level. In the period of 2007-2013, the indicators were set at the measure level. The impact of the implementation of the ERDP is assessed in four sections (Figure 7.10).

**Figure 7.10. Monitoring and evaluation system of the ERDP**

Ministry of Rural Affairs

Ex-post evaluator

Ongoing evaluator

AIR submitted 2017 and 2019.

Progress reports

Ex-ante and Strategic Environmental Assessment evaluator

CMES

CMEF

National additional indicators

Impact indicators

Evaluation questions

Target and result indicators

Output indicators

Ex-ante and Strategic Environmental Assessment evaluator

Ongoing evaluator

Other evaluators

Ex-post evaluator

Ministry of Rural Affairs

CMES 2014-2020 Common indicators and programme specific indicators and evaluation questions on the priority and focus area level

CMEF 2007-2013 Common output, result and impact indicators and questions on the measure and priority level

Source: on the basis of MRA (2016b)

1. Ex-ante evaluation aims at improving the quality, performance and efficiency of the development and implementation of the ERDP, taking into account the objective assessments and recommendations of independent evaluators and optimizing the allocation of budgetary resources. Ex-ante evaluation is performed during the preparation of the ERDP. Furthermore, the evaluation of the Strategic Environmental Assessment (SEA) and the budget for the ERDP is carried out in parallel with the assessment. Ex-ante evaluation is conducted by independent experts who have been found by way of competitive tender.
2. The mid-term evaluation, which was implementd in 2007-2013, is designed to assess the implementation of the ERDP and the evaluation activities made during the ongoing evaluation. The evaluation process builds on the results of ongoing evaluation. The evaluators are found through public procurement. For the period 2014-20 mid-term evaluation was replaced by strategy reports, which must be submitted twice during the programming period (in 2017 and 2019).
3. Ex-post evaluation is intended to assess the further impact of the ERDP, the use of resources, the effectiveness and efficiency of rural development support. Conclusions on the implementation of the rural development policy, including the contribution to the implementation of the EU CAP are drawn on the basis of the ex-post evaluation results. The evaluators are found via public procurement.
4. Each year Estonia submits the EC a report on the implementation of the ERDP in the previous calendar year, and twice during the programming period an additional improved operational report on the implementation of ERDP covering information regarding the implementation of the partnership agreement. Strategy reports are compiled twice during the programming period. Strategy reports are submitted to the European Parliament and the Council, and it is focused on the implementation and the results of the agricultural policy.
5. MRA compiles quarterly reviews on food industry. The data in the surveys come from of the Statistics Estonia in the form of monthly, quarterly and annual statistics time series. The following sectors of the food-processing industry sectors are deemed food industry: the manufacture of meat, fish, fruit and vegetables, oil, dairy products, grain mill products, manufactured animal feeds, and beverages (MRA, 2016c).

Availability of input and output indicators

1. Different evaluations are carried out to identify the efficiency of the systems, programmes, measures, activities and projects. Indicators have been developed to measure the results, the changes as a result of the intervention and the performance of the participants. So far, the RDI indicators applied in Estonia have primarily been focused on the use of input and output indicators comparable to the EU that describe and analyse the dynamics of the RDI system based on the framework of EU policies and objectives. The current use of indicators has thus been of monitoring nature. The development of more detailed indicators with intervention logic is carried out in the preparation phase of the specific operational plans and programmes (Karo et al., 2014). The criteria used for the evaluation of indicators are in this case divided into three groups: validity (is the indicator measuring something that is wanted to measure) and reliability (replicability of results), efficiency (source data availability and processing costs), and quality (simplicity of use and impact). The indicators are assessed and the relevant recommendations are made by the expert analysts during the ex-ante evaluation of the new strategy. Indicators are divided into input, output and performance indicators (Figure 7.11) (Masso et al., 2013). Similar indicators are used in the field of agriculture and in the Monitoring and Evaluation System of the ERDP.

**Figure 7.11. Types of indicators**

*Structure of the programme, measure, project*

*Structure of the results*

Results in long perspective (impact)

Results in medium-term perspective

Results in short perspective

Outputs (direct outcomes of the activities)

Activities

Inputs (resources)

Source: based on Masso et al. (2013)

1. At measure level, monitoring data collection and reporting is carried out through ARIB and other relevant institutions, including the Foundation Private Forest Centre (PFC), LEADER local action groups and the RERC. Once a year ARIB prepares and submits an annual report to MRA on the basis of relevant information. The reports from ARIB, other relevant authorities and permanent evaluators provide a foundation for the surveillance report of MRA. Annual monitoring reports reflect the output indicators and their achievement, whereas the interim reports also contain information on the results and their impacts. Figure 7.12 gives an overview of the ERDP monitoring system, which also collects information on innovation.

**Figure 7.12. The ERDP monitoring system, including information on innovation as horizontal priority**

Evaluation of measures

Annual monitoring report to the EC

MRA

LEADER LAGs, PFC, RERC

Ongoing evaluators

ARIB as paying agency

National additional indicators

Result indicators

Context indicators

Input indicators

Output indicators

Source: on the basis of MRA (2016b)

1. In ERDP 2007-2013, the measures supporting innovation were under the vertical priority of “Improving the competitiveness of agricultural and forestry sectors”. In ERDP 2014-2020, the measures that support innovation are under the horizonthal priority “Fostering innovation, cooperation, and the development of the knowledge base in rural areas”. In the ERDP 2014-2020, there are no specific measures under this priority. The measures are part of measures of other target areas (“Knowledge transfer and information”,”Support for advisory services”, and ”Cooperation”). The respective innovation indicators are presented in Table 7.2.
2. In addition to indicators, the EC has developed common evaluation questions, which Estonia, as an EU member has to answer. Evaluations questions in the field of innovation in 2014-2020 are quite similar to those used in 2007-2013. In 2007-2013, the evaluation questions were measure-based, however, in 2014-2020, they are priorities’ target areas’ based (Table 7.3).
3. In 2014-2020, impacts are assessed in the phases of strategy reports and ex-post evaluation. Compared to 2007-2013, the new evaluation system is implemented more at macroeconomy level. Therefore, more effective evaluation of impact of innovation at measure and project level shoud be developed.
4. In summary, the various indicators of innovation policies in national innovation strategies are presented in Table 7.4. (Note: In addition to the evaluation of ERDP implementation, the respective results achieved by agriculture-related companies/organizations are assessed in the course of the evaluation of all strategies listed in the Table 7.4, (including RDI policy, Sectoral R&D activities and Entrepreneurship and innovation policy)).

**Table 7.2.** Indicators for the measures supporting innovation in programming periods 2007-2013 and 2014-2020

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2007-2013 | | | | 2014-2020 | | | |
| Measures | Output indicator | Result indicator | Impact indicator | Focal sectors/measures | Target indicator | Output indicator | Result indicator |
| *Priority:* improving the competitiveness of the agricultural and forestry sector | | | | *Priority: Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas* | | | |
| Training and information activities | No. of participants in training and information sessions; No. of training and information sessions a year | No. of successful completions | GVA changes per unit labour costs per year; Additional indicators: proportion of managers of agricultural holdings with basic and full education; proportion of adult population participating in life-long learning | Fostering innovation, cooperation, and the development of the knowledge base in rural areas  Measures:  - Knowledge transfer and information;  - Advisory services;  - Farm management and farm relief services  - Cooperation | Share of expenditure from the total ERDP expenditure | Total public expenditure;  total public expenditure on training and mobility and promotion schemes of agricultural enterprises | % of innovative projects out of all RDP supported projects; Number and types of partners involved in cooperation projects; Number of supported innovative actions implemented and disseminated by EIP operational groups |
| Support for advisory system and services | No. of agricultural producers and private forest owners supported  No. of centres reformed | Increase in GVA of agricultural producers and private forest owners supported | GVA changes per unit labour costs per year | Strengthening the links between agriculture, food production and forestry and research and innovation, including for the purpose of improved environmental management and performance  Measures:  -Cooperation | Total No. of cooperation projects (groups, networks/clusters, pilot projects, etc.) supported | No. of EIP working groups supported (creation and activity);  No. of other cooperation projects (groups networks/clusters, pilot projects, etc.) supported | % of cooperation operations continuing after the RDP support including for the purpose of improved environmental management and performance Number and types of partners involved in cooperation projects |
| *Priority: Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests* | | | |
| Modernisation of agricultural holdings | No. of agricultural entrepreneurs and producers supported; the volume of investments per programming period | No. of agricultural entrepreneurs and producers making innovative products or use innovative technologies per programming period; Increase in NVA by the end of the programming period | Growth in NVA and change in GVA per unit labour costs by the end of the programme | Improving the economic performance of all farms and facilitating farm restructuring and modernisation, notably with a view to increasing market participation and orientation as well as agricultural diversification  Measures:  -Knowledge transfer and information;  -.Advisory services;  - Farm management and farm relief services;  - Investments into real property;  - Development of agricultural; holdings and entrepreneurship;  - Cooperation | The share of agricultural holdings receiving support for investments in the re-organization and modernisation from the ERDP | No. of participants in training; total public expenditure on education and skills acquisition actions, mobility and promotion in agricultural holdings; No. of beneficiaries receiving counselling; No. of agricultural holdings receiving support for investing in agricultural holdings; total public expenditure on investments in infrastructure; No. of agricultural holdings receiving business start-up aid for setting up small-scale agricultural enterprises | % of agriculture holdings with RDP support for investments in restructuring or modernisation  *Complementary result indicator:*  Change in agricultural output on supported farms/AWU (Annual Work Units) |
| *Priority Promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture* | | | |
| Improving the economic value of forests and  adding value to forestry products | No. of properties supported;  Total volume of investments  No. of prevention and restoration actions | Boosting the production potential and value of forests; No. of micro-enterprises applying new products and innovative technologies |  | Improving competitiveness of primary producers by better integrating them into the agri-food chain through quality schemes, adding value to agricultural products, promotion in local markets and short supply circuits, producer groups  and organisations and inter-branch organisations  Measures:  - Knowledge transfer and information;  -.Advisory services;  - Farm management and farm relief services;  - Quality assurance schemes for agricultural and food products  - Investments into real property;  - Creation of producer groups and organisations  -Cooperation | Share of agricultural holdings receiving support through quality assurance schemes, local markets and short supply chains, producer groups and organisations | No. of participants in training; total public expenditure on education and skills acquisition actions, mobility and promotion schemes in agricultural holdings; No. of beneficiaries receiving counselling; No. of activities receiving support for investments; No. of activities receiving support for producer group creation; No. of agricultural holdings participating in activities of the supported producer groups; No. of agricultural holdings involved in the cooperation within the supply chain or promote cooperation on the local level | % of agricultural holdings receiving support for participating in quality schemes, local markets and short supply circuits, and producer groups/  organisations |
| Measures | Output indicator | Result indicator | Impact indicator | Focal sectors/measures | Target indicator | Output indicator | Result indicator |
| Adding value to agricultural and non-wood  forestry products | No. of enterprises and cooperative societies supported; total volume of investments | No. of of enterprises and cooperative societies introducing new products and innovative technologies | Net value added expressed in purchasing power standard (PPS), (% of EU average); change in GVA per unit labour costs per year | Supporting farm risk prevention and management  Measures:  - Advisory services;  - Farm management and farm relief services. | No. of agricultural enterprises participating in risl management schemes | No. of beneficiaries receiving counselling;  total public expenditure | % of farms participating in risk management schemes |
| Development of new products, processes and technologies in the sectors of agriculture, food and forestry | No. of cooperation projects supported | No. of entrepreneurs  introducing new products and innovative technologies | Net value added expressed in purchasing power standard (PPS), (% of EU average); change in GVA per unit labour costs per year |  |  |  |  |

*Sources:* based on Estonian Rural development Plans for programming periods 2007-2013 and 2014-2020 and Common evaluation questions for rural development programmes 2014-2020

**Table 7.3.** Evaluation questions concerning innovation about the implementation and impact of the ERDP in 2007-2013 and 2014-2020

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2007-2013 | | 2014-2020 | | |
| Measure | Evaluation question | Priority | Focal sector | Evaluation questions |
| Training and information activities | To what extent have the training, information, knowledge and innovative practices dissemination activities improved labour productivity and/or other elements related to competitiveness in the agricultural, food and forestry sector? To what extent have the training activities contributed to improving sustainable land management, including sustainable use of natural resources? To what extent are the supported training courses in accordance with the actual needs and coherent with other measures of the programme? | Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas | Fostering innovation, cooperation, and the development of the knowledge base in rural areas | To what extent have RDP interventions supported innovation, cooperation and the development of the knowledge base in rural areas?  RDP projects have been innovative and based on developed knowledge • Operational groups have been created • Variety of partners involved in EIP operational groups • Innovative actions have been implemented and disseminated by the EIP operational groups |
| Support for advisory system and services | To what extent has the measure improved the management and economic performance of agricultural and forestry enterprises? Specify the following aspects: production techniques; quality standards: occupational safety; management of natural resources. To what extent has the measure contributed to improving the human potential in the agricultural sector? To what extent has the scheme contributed to improving the competitiveness of the agricultural sector? |  | Strengthening the links between agriculture, food production and forestry and research and innovation, including for the purpose of improved environmental management and performance | To what extent have RDP interventions supported the strengthening of links between agriculture, food production and forestry and research and innovation, including for the purpose of improved environmental management and performance?  Long term collaboration between agriculture, food production and forestry entities and institutions for research and innovation has been established • Cooperation operations between agriculture, food production and forestry and research and innovation for the purpose of improved environmental management and performance have been implemented |
| Modernisation of agricultural holdings | To what extent have investment grants contributed to a better use of production factors in agricultural enterprises? Specifically, to what extent have investment grants facilitated the introduction of new technologies and innovation? To what extent have investment grants enhanced the market access and market share of agricultural enterprises? To what extent have investment grants contributed to long-term and sustainable activity of agricultural enterprises? To what extent have investment grants contributed to improving the competitiveness of the agricultural sector? | Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests | Improving the economic performance of all farms and facilitating farm restructuring and modernisation, notably with a view to increasing market participation and orientation as well as agricultural diversification | To what extent have RDP interventions contributed to improving the economic performance, restructuring and modernization of supported farms in particular through increasing their market participation and agricultural diversification?  Agricultural output per annual working unit of supported agricultural holdings has increased • Farms have been modernized • Farms have been restructured |
| Improving the economic value of forests | To what extent have investment grants contributed to the diversification of the production of forest enterprises? To what extent have investment grants contributed to increasing the market share of forest enterprises, and improving market access in such sectors as renewable energy? To what extent have investment grants contributed maintaining or improving the sustainable management of forests? To what extent have investment grants contributed to increasing the competitiveness of forest holdings? | Promoting food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture | Improving competitiveness of primary producers by better integrating them into the agri-food chain through quality schemes, adding value to agricultural products, promotion in local markets and short supply circuits, producer groups and organisations and inter-branch organisations | To what extent have RDP interventions contributed to improving the competitiveness of supported primary producers by better integrating them into the agri-food chain through quality schemes, adding value to the agricultural products, promoting local markets and short supply circuits, producer groups and inter-branch organization?  Competitiveness of supported primary producers has improved • The share of the final price of agriculture products retained with primary producers has increased • The added value of agricultural products of primary producers has increased  Implementation of quality schemes by primary producers has increased • Participation of primary producers in short circuit schemes, quality-oriented producer group and/or inter branch organization has increased |
| Adding value to agricultural and forestry products | To what extent have investment grants contributed to introducing new technologies and innovation? To what extent have investment grants contributed to improving the quality of agricultural and forestry products? To what extent have investment grants contributed to improving the efficiency of agricultural and forestry product processing and marketing? To what extent have investment grants contributed to enhancing the market access and market share of agricultural enterprises and forest holdings, including in such sectors as renewable energy? To what extent have investment grants contributed to improving the competitiveness of the agricultural and forestry sector? |  | Supporting farm risk prevention and management | To what extent have RDP interventions supported farm risk prevention and management?  Participation of farms in risk prevention and management schemes has increased |
| Cooperation in the sectors of agriculture, food and forestry to develop new products, processes and technologies | To what extent has the support enhanced the market access of primary agricultural and forestry products and the market share of innovative products, processes and technologies developed in cooperation between the participants in the production chain? To what extent has the support contributed to improving the competitiveness of agricultural, forestry and food sector? |  |  |  |

Sources: based on Guidelines for ongoing assessment, rural development programmes in 2007-2013 and Common evaluation questions for rural development programmes 2014-2020

**Table 7.4.** Innovation policy indicators in national strategies

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Policy | Responsible institution | Evaluation frequency | Data sources | Submitted to: | Innovation indicators |
| RDI policy | Ministry of Education and Research  *(sectoral RDI indicators are presented to MER by sectoral ministries, including MRA)* | Once a year | Eurostat; Statistics Estonia; Innovation Union Scoreboard; Surveys on Strategy “Europe 2020“ implementation;OECD;  Estonian Education Information System  EHIS; Scopus/Science Metrics; Thompson Reuters Web of Science; Horizon 2020 database | National government | Proportion of RDI, including private investments, % GDP;\*productivity per employee, % of the EU average,  Place of Estonia in the European Innovation Scoreboard;  Number of defended PhD theses in a study-year;  Number of high-level articles belonging to the 10% of the most cited articles in the world;  Number of high-level articles per one million inhabitant;  Share of private investments in the RDI of the public sector;  Share of financing earmarked for socio-economic activities (except academic research) in the RDI allocations in the state budget;  Share of high-tech products and services in export, %;  Employment in high-tech sector from total employment, %,  Estonia’s success in Horizon 2020, including the volume of financing received per inhabitant, % of EU average;  Share of internationally coordinated research from the state supported R&D activities;  Number of joint publications of public and private sector (Innovation Union Scoreboard) |
| Sectoral R&D activities | Sectoral ministries, including MRA | Once a year | Statistics Estonia | MER | Number of employees engaged in research and development;  Internal and external expenditures on R&D of enterprises in entrepreneurship sector;  Number of employees engaged in R&D activities in non-profit sectors  Number of employees engaged in R&D activities in non-profit sectors by field of action;  Expenditure on R&D by institutional sector and types of expenditure;  Expenditure on R&D and their financing from the state and municipal budget |
| Entrepreneurship and innovation policy | MEAC | Once a year or every other year | Business register, Enterprise Estonia | National government | Number of enterprises cooperating in the field of innovation;  R&D expenditures in enterprises;  Added value per employee;  Number of enterprises launching innovative products;  Number of innovative ideas entering the market;  Revenues from sales, including revenues from innovative products;  Export income and net income of an enterprise. |
| Agricultural innovation policy  (as expressed in ERDP) | MRA | Once a year | Statistics Estonia, ongoing evaluator, World Economic Forum | EC | Planned output indicators in 2014-2020:  Public sector expenditure on knowledge transfer and dissemination (including training, demonstration and dissemination activities, visits to enterprises, workshops);  Number of participants in training;  Public sector expenditure on counselling services (including individual counselling and training of counsellors) and agricultural enterprise management and replacement activities;  Public sector expenditure on enhancing cooperation (including the development of innovation clusters, new products, practices, processes and technologies);  Number of EIP working groups supported (launch and activity);  Number of other cooperation projects (groups, networks, clusters, test projects, etc.):  Additional indicator that were measured in 2007-2013:  Economic growth (measured through the net added value earned by the beneficiary (PPS, % of EU27 average);  Productivity of labour;  Competitiveness (better economic results, more efficient use of resources, etc. as compared to other enterprises);  Labour efficiency and wages;  Efficiency of production and marketing;  Economic sustainability (expressed through financial ratios of beneficiaries). |

Sources: based on MRA (2016b), MER (2014), EMU (2015b), Mihkelson et al. (2014)

### Benchmarking tools

1. In the course of ongoing evaluation, the assessors analyse the implementation of the planned measures, as well as the fulfilment of the objectives set. EMU and ARC analyse the impact of the implementation of the agricultural innovation policy. ARIB registers, records of other pertaining institutions, research data on a sector basis, and form various collections (Agricultural Board, Statistics Estonia, FADN, etc.) are used during the analysis.
2. In the assessment of the achievements in RDI, mainly official and internationally comparable statistics (Eurostat, Statistics Estonia; Innovation Union Scoreboard, Europe 2020 implementation surveys, the OECD, the Estonian Education Information System EHIS; Scopus/Science Metrics; Thompson Reuters Web of Science, the Horizon 2020 database) is used, which the attained target objectives or levels are checked against.
3. The development of measures for the achievement of the objectives of the sector-specific development plans is preceded by an ex-ante evaluation and the feasibility analysis, which include a comparative analysis of the objectives, the current situation and the context (necessary preconditions for the implementation of the instruments). The feasibility study also analyses similar experiences of other countries in implementing the measures (e.g., development of demand-side measures for the innovation policy).
4. In the course of mid-term and ex-post evaluations, experts compare the implementation results to the objectives set. Comparisons between the various sectors and performance within the sector are also carried out. The impact of support for entrepreneurship and innovation and loans on enterprises is also evaluated through comparative analysis. The enterprises granted the support are compared against businesses that have not used the support. The economic indicators of the company and surveys are used as data source.
5. The effectiveness analysis comparing the implementation of innovation policy between the EU countries is conducted by the EC, which annually collects the necessary input data for the analysis from the Member States, including Estonia.

### Evaluation of economic, environmental and social impacts of innovation

1. In case of both the ERDP 2007-2013 and ERDP 2014-2020, the impact of the innovation measures and innovation measures from other focal sectors on the economy, environment and the social sphere is assessed. These questions are reflected in the EC common evaluation questions for rural development. The results of the economic, environmental and social aspects are nationally assessed in the course of mid-term and ex-post evaluations (in the new period during the compilation of the strategy report). As compared to the 2007-2013 period, in the new period the above-mentioned aspects are evaluated horizontally, whereas in 2007-2013 the results were assessed both based on the measure and through general evaluation questions horizontally. In both periods, assessing the outcome of the support interventions andtheimpact of innovation on economy has received the most attention. The impact of innovation on the environment and social aspects has been evaluated indirectly through the implementation of agricultural policy and support schemes earmarked for development. Tables 2 and 3 present the indicators reflecting the innovation performance on the economy, as well as the evaluation questions. Indirect effects of the innovation performance on the environment are assessed through the impact of investment grants on forest area management, preservation and improvement of biodiversity, ensuring animal welfare, developing farming systems, maintaining and improving water and soil quality, mitigating the effect of climate change, etc. The impact of innovation activities on the social aspects are assessed through the overall improvement in the quality of life in rural areas, an increase in employment growth and the promotion of entrepreneurship.

### Evaluation methods and frequency

1. The impact of the RDI strategy on enterprises has been inclusively estimated in a number of studies (mainly in the framework of research and innovation monitoring program). Several measures have been studied in the ‘analytical matching framework’, where a control group was created. The control group was similar in all other characteristics, but did not receive the support. The performance of different groups was compared to identify the impact of the support. For example, in 2012, the Estonian Audit Office, which is also authorized to study the country-wide innovation impact on the enterprise competitiveness, in collaboration with Statistics Estonia, carried out an ‘analytical matching framework’ study and survey into the impact of innovation support measures. To assess the impact of the innovation support measures, enterprises receiving subsidies for the years 2004-2012 from EE were interviewed in 2012 and compared to enterprises not supported. The enterprises supported were asked how the received support affected the company’s economic indicators (revenue, exports, value added), whether new products or services had been developed, etc. Enterprises not supported were asked to explain why they had not applied for support. Both groups of the enterprises were asked which kind of support companies should offer (NAO, 2014). TUT’s researchers studying the same issue with a slightly different methodology than the Estonian Audit Office came to the practically same conclusions. Both studies showed that there were positive correlations with the company’s turnover and number of employees, but the correlation with performance (productivity) could not be found, or a statistically significant negative correlation was detected. The general problem of the studies performed was that the time between receiving the grant and measuring the results was too short, which is the reason the results reflect the corporate profile of the companies receiving support rather than the effectiveness of the support (Ukrainski et al., 2015a).
2. The problem in assessing the success of the implementation of the programs is a time-lag between the programme outcomes and their effects, which may take years. Usually the immediate control over the programme ends with the outputs. The changes induced by the outputs are affected by all sorts of external factors. The longer is the delay between the output of the programme and the impact of the achieved output, the more uncontrollable factors intervene in the chain. However, it is this delayed impact that is of real importance, which should be evaluated (Masso et al., 2013).
3. Compared to the input and output indicators of the programs, projects and activities, the use of result indicators has been limited despite the fact that performance indicators should make it clear what the actual impact of the intervention has been. The use of impact indicators in RDI fields, however, is difficult because the effects can be very versatile by nature (and, therefore, in recent assessments more and more attention is being paid to the so-called behavioural added value, where, e.g. the beneficiary of the supported R&D projects or research cooperation continues the use and expansion of the RDI network to meet the challenges facing them), and/or the impact of the specific intervention may manifest itself only after a longer period (Karo et al., 2014).

### Use of evaluation results in priority setting and decision making

1. Thematic objectives and key actions have been agreed upon in the pan-European strategic coherence framework (EC, 2012). During the period 2014-2020, the rural development policy is included in the common pan-European strategic frameworks of the ERDF, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund. As a part of the joint planning a partnership agreement is negotiated and signed with the EC at the national level.
2. In setting long-term objectives, Member States, including Estonia, comply with the sectoral and cross-sectoral (including innovation) Europe-wide objectives, thereby contributing, through the implementation of the objectives, to the improved competitiveness on the European level. The Member States, including Estonia, also base their choice of measures for achieving the objectives on the key actions of the EU, taking into account national/regional specificities. The adoption of every new sectoral strategic plan is preceded by an ex-ante evaluation, which input includes results of the performance and impacts assessment of the previous programming period, as well as the analysis of economic trends and the international and national economic environment. Inputs are the basis for the formulation and development of the new economic and innovation policy. Ex-ante evaluations usually take place in parallel with the elaboration of the development plans for the new period, which is why the reason the inputs are up to date. Ex ante, mid-term and ex-post evaluations are carried out by experts who give expert opinions and recommendations related to the goals and measures of the new period.
3. The Research and Development Council (RDC) advises the Government in matters relating to the development of the national research, development and innovation system. The RDC advises the Government on the preparation of the draft state budget in respect to the amounts prescribed for research and development, on the establishment and reorganisation of research and development institutions and the termination of their activities and on establishing the conditions and procedures for the evaluation of research and development. The RDC also presents its opinion to the Government on the national research and development programmes presented by the ministries and on the objectives of research and development policy for the forthcoming period (Government Office of the Republic of Estonia, Research and Development Council. https://riigikantselei.ee/et/valitsuse-toetamine/teadus-ja-arendusnoukogu, 15.11.16)

## Public and private investment in innovation

*The public sector continues to be the main source of funding for agriculture R&D, whether performed in public or private organisations. A wide variety of funding mechanisms are used from direct spending on research projects, including for Public-Private Partnerships (PPPs) and “pull mechanisms”, to various forms of tax incentives. Business investment in R&D is normally driven by market demand, but governments also provide different kinds of incentives. Some, like R&D tax rebates, apply to the economy in general, while others are agriculture specific. In many countries, producer organisations and other non-governmental organisations also provide R&D funding. Knowledge infrastructure is a public good that can enable innovation; it includes ICT infrastructure and general purpose technologies as well as specific knowledge infrastructure such as databases and institutions.*

### Priority areas for public research in agriculture

1. The general priorities for public research in agriculture stem from the EU level, national horizontal and sectoral strategies (Figure 7.4). The overall priorities and measures for Estonian R&D policy are defined in Knowledge-based Estonia (MER, 2013).
2. MRA is responsible for planning, coordination and implementation of R&D activities in agricultural sector in order to support policymaking, knowledge transfer, training, and application of research. MRA finances applied research, knowledge transfer and innovation in agriculture, food and fisheries sector through national programmes “Agricultural Applied Research and Development from 2015–2021”, “Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014–2020”, “National Programme for Plant Breeding from 2009–2019”; and through measures of ERDP 2014-2020 and European Maritime and Fisheries Fund’s operational programme (MRA, 2016d).
3. The main priorities for Estonian agriculture are set by ERDP 2014-2020 and are based on the six common rural development policy priorities defined at the EU level. Among those, priority 1 addresses innovation and knowledge transfer.
4. “Estonian agriculture, food and fisheries science and knowledge transfer development plan for 2015- 2021“ (MRA, 2016f) is a framework document that sets the objectives for research and knowledge transfer in MRA’s governance area and directions for planning and coordinating different research measures in order to achieve their cohesiveness, including with EU level and national horizontal and sectoral strategies (see Figure 7.6). The development plan addresses research in veterinary medicine; food technologies and food safety; animal production, incl. animal breeding; crop production, incl. plant breeding; horticulture (berries, fruits, ornamental horticulture); fisheries science, incl. aquaculture; and in rural economics. The general aims for research in agricultural sciences are aligned with the EU level and national horizontal strategies, and ERDP 2014-2020. The priority fields for agricultural sciences (stemming from Europe 2020) are climate change and resource efficiency, food safety, health care and aging, environmentally friendly production methods and land use. The specific aims for agricultural research in Estonia are: 1) Competent scientific support for designing and implementing CAP and fisheries policy; 2) Competent scientific support for the agriculture, food and fisheries sector; 3) Sustainability of scientific community; 4) State-of-the-art facilities and infrastructure; 5) Estonian researchers participation in international research cooperation; 6) Plant and animal breeding; plant genetic resources ex situ conservation and collection; 7) Effective knowledge transfer, incl. between R&D organisations and agricultural producers (MRA, 2016f).
5. The three national programmes for applied research are one part of the framework for research and knowledge transfer in Estonian agriculture, food and fisheries sciences The specific objectives set by national programmes for applied research are described below.

* “Agricultural Applied Research and Development from 2015-2021”[[13]](#footnote-14) – during 2009-2014, the main aims were to increase competitiveness of agricultural production and processing, to ensure its sustainability, analysis of risks associated with agricultural production and produce, and risk management solutions. In the period 2015-2021, the main aims are to provide science based input to MRA for policy making, law making and monitoring; and to coordinate and to finance participation in international research cooperation (MRA, 2016d). The programme addresses following areas of activity and specific aims:
* Food safety, animal welfare and health; plant health and quality of production input – to ensure the safety of food produced and consumed in Estonia; to ensure animal welfare and good condition of animal and plant health; to ensure quality and safety of agricultural production inputs.
* Rural life, agriculture and food industry – to ensure sustainable food production; to conserve traditional agricultural landscapes, clean environment and biodiversity; to ensure balanced development of agricultural regions and improvement of rural living environment.
* Fishing industry – to ensure competitive and sustainable fishing industry.
* “Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014-2020”[[14]](#footnote-15) – the programme addresses the commitments that Estonia has taken with international agreements, such as the Convention on Biological Diversity, the Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture, and the International Treaty on Plant Genetic Resources for Food and Agriculture. The main aims are to ensure the collection and conservation, evaluation of plant genetic resources for food and agriculture, and the wider utilization and availability of plant genetic resources for research and study, plant breeding and to other non-profit users. The programme serves as a basis for “National Programme for Plant Breeding 2009-2019” as well as contributes to overall goals of sustainable development of plant breeding and conservation in Estonia, healthy and safe food, the sustainable use of natural resources, the maintenance of genetic and landscape diversity, and the reduction of climate change hazards (MRA, 2013).
* “National Programme for Plant Breeding from 2009-2019” – the main aims are to ensure the sustainable development of Estonian plant breeding and to preserve existing varieties; to breed varieties that help to increase the competitiveness of agricultural sectors; healthy and safe food; sustainable use of natural and environmental resources and preservation of genetic and landscape diversity; reduce the threats of climate change (MRA, 2008).

### Integration of issues of sustainable natural resources use, environmental protection and climate change in agricultural innovation policy; research priorities in these areas

1. Sustainable natural resources use, environmental protection and climate change are addressed in national horizontal strategies and through ERDP priorities and measures as well as in the objectives of national programmes of applied research (MRA, 2016f). On the basis of Europe 2020, ”Estonian agriculture, food and fisheries science and knowledge transfer development plan for 2015-2021“ sets climate change and resource efficiency, food safety, health care and aging, environmentally friendly production methods and land use as priorities for agricultural sciences in Estonia.
2. General problems associated with climate change adaption include lack of awareness among population and on local governmental and regional level, lack of awareness raising by scientist and local authorities (MOE, 2016a); unknown impacts of climate change in regional level, lack of finances and trust for adaption of strategies at local level (SEI Tallinn, 2016). More attention should be paid raising public awareness on the climate change and on adaption strategies for climate change (MOE, 2016a).
3. In “Estonian agriculture, food and fisheries science and knowledge transfer development plan for 2015-2021“ (MRA, 2016f) the climate change, resource efficiency, food safety and environmentally friendly production methods and land use are prioritised. In the national programmes for applied research, the main priorities concern food safety, animal and plant health, environmentally friendly plant protection, sustainable food production, and conservation of landscape, clean environment and biodiversity.
4. MRA represents Estonia at the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI),that sets the strategic priorities for trans-disciplinary and innovative European research on agriculture, food security and climate change (MRA, 2016f). It provides a framework for the alignment of national programmes and joint research efforts. There are 5 core themes: sustainable food security under climate change; environmentally sustainable growth and intensification of agricultural systems under current and future climate and resource availability; assessing and reducing trade-offs between food production, biodiversity and ecosystem services; adaptation to climate change; greenhouse gas mitigation (FACCE-JPI, 2016).

### Decisions making of public funding

1. The general spending volume is agreed on in government, but also taking into consideration the counsel from RDC. Priorities and funding for those are planned in budget strategy and annual budget preparation process taking into account the different strategies and four-year organisational development plans of ministries. Ministries submit budget bids to Ministry of Finance and negotiate. Government approves the draft budget that is presented to Parliament for adoption (Kraan et al., 2008).
2. MEAC and MER are responsible for most of the public research funding streams and horizontal policies as they determine the types of policies funded and distribute the funds to their implementing agencies (EE, Kredex for MEAC and ERC, Archimedes Foundations for MER), and distribute certain funds themselves (ERC, 2013). The Minister of Education and Research is counselled by the Research Policy Committee that also makes proposals on policy, R&D financing principles and strategies (MER, 2015). MRA is responsible for supporting research in agricultural field. MRA is counselled by Council of Agricultural Sciences.
3. The main research funding instruments financed from the Estonian state budget are: base funding; research funding – institutional research grants and personal research grants; national research and development programmes; financing of centres of excellence and doctoral schools and covering the expenses of research and development infrastructure (MER, 2015). Majority of public research funding in Estonia is at present project based and is distributed through competitive calls in which applicants are evaluated by peer-review. Table 7.5 summarizes the main research funding instruments funded through MER, MEAC and MRA.
4. In addition to research and innovation funding, 3.87% of ERDP expenditure (of 992 mil eur; in ERDP 2007- 2013 1.54%; MRA 2016b) will be allocated for measures: ‘Knowledge transfer and information’; ‘Advisory services, farm management and farm relief services’; ‘Coope*ration’.*

**Table 7.5.** Most relevant funding measures for AIS most relevant funding measures for AIS

| **Types of funding/programmes** | **Purpose** | **Financing/ connection with AIS** | **Evaluation of applications** |
| --- | --- | --- | --- |
| Baseline funding | To provide funding for them to attain their strategic development goals, for co-financing foreign and domestic projects and for opening up new research directions | 2005-2015 77.7 mil EUR  Agricultural science[[15]](#footnote-16)s 1.46 mil EUR | Main institutional, non-competitive instrument, distributed by the decision of the minister. The funds allocated for base financing from the state budget are provided to applicants based on the results of their R&D activities in previous three years (publications, patents, R&D funding, PhD defences). |
| Institutional research grants (replacing the previous target financing) | To finance high-level R&D, and related activities (research themes) of an institution to ensure the consistency of the R&D and to supplement and maintain the necessary infrastructure | Most sizeable research support measure.  2007-2015 207.2 mil EUR (incl. target financing).  Agricultural sciences 13.5 mil EUR. | Competitive, project-based. Applications are evaluated by committee of national and international experts |
| Personal research grants | Innovative or high-risk research projects carried out by researchers or small research groups | 2009- 2015 53.5 mil EUR (incl. ERC grants)  Agricultural sciences 1.7 mil EUR. | Competitive, project-based. Applications are evaluated by committee of national and international experts |
| Centres of Scientific Excellence | Formation of consortium by internationally recognised research groups to improve the quality and efficiency of scientific research through cooperation | 2008-2015 44.7 mil EUR; max. amount per project 7.7 mil EUR, at least 5% co-financing requirement  Centre of Excellence in Environmental Adaptation ENVIRON coordinated by EMU is one of the 12 centres created; funding 3.0 mil EUR. | Applications evaluated by committee of national and international experts |
| Competence centre programme | Formation of competence centre by consortium of enterprises and R&D institutions for innovative product development and cooperation | 2014-2020 40 mil EUR, max. amount 7 mil EUR per centre; at least 40% of financing from the consortium partners  Out of the 8 centres established, three are related to AIS.  Centre of Food and Fermentation Technologies (TFTAK);  The Competence Centre on Health Technologies (CCHT);  Bio-Competence Centre of Healthy Dairy Products LLC (BioCC) | Applications are evaluated by committee of national and international experts |
| Regional Competence Centres | Support to regional entrepreneurship and labour market through cooperation between enterprises and R&D institutions to create knowledge intensive entrepreneurship (outside largest cities Tallinn and Tartu) | From 2014- 2020 14 mil EUR.  The max. support per centre 0.7 mil EUR; at least 15% self-financing from partners.  In 2009- 2014 support per centre maximally 3.19 mil EUR.  Out of 6 centres established since 2009, one is part of AIS:  Competence Centre for Knowledge-Based Health Goods and Natural Products | Application are evaluated at first by two appointed experts; followed by evaluation by a committee formed by EE. |
| Agricultural Applied Research and Development from 2015-2021 | Competent scientific input for agricultural policy and law making and monitoring; and coordination and financing of participation in international research cooperation | 2015-2021: 9.61 mil EUR (in 2009-2014 7.4 mil EUR) | Competitive, project-based. Steering committee decides on project calls and ordering of ongoing expert opinions and participation in international network projects. |
| Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014–2020 | Collection, conservation, evaluation, and wider utilization and availability of plant genetic resources for food and agriculture | 2014- 2020: 1.76 mil EUR (2007- 2013 1.35 mil EUR) | Non-competitive; but applications are evaluated by different departments in MRA |
| National Programme for Plant Breeding from 2009–2019 | To ensure the sustainability of Estonian plant breeding and to preserve existing and breed new varieties | 2009-2012 3.6 mil EUR |

Sources: compiled on basis on ERC 2015c; 2016a, EE, 2016; Etis, 2016; MER, 2015; ERC, 2014; MRA, 2013, 2016h, 2016i, EE, 2016a

### Nature of collaboration with the private sector or international researchers

1. Lack of collaboration between private sector and R&D institutions is one of the central concerns pointed out in current as well as in previous national R&D strategies. A comparison from the 2006 indicated that private sector’s participation in implementation and assessment of R&D polices was very limited in Estonia. Most common was participation through industrial associations in steering committees, boards, and occasionally in networks (Inzelt, 2006).
2. Representatives of private sector are included into the different advisory councils that can contribute to the formulation of financing policies in Estonia, e.g. in RDC and in Research Policy Committee. Council of Agricultural Sciences at the MRA includes representatives of farmers’ organisations. At present, out of 14 members (incl. chair and vice-chair) of Council of Agricultural Sciences, three members are representatives of sector (representing Estonian Chamber of Agriculture and Commerce, Central Union of Estonian Farmers, Estonian Farmers Federation); one represents advisory system (RDF); four represent MRA, six represent R&D institutions (MRA, 2016g).
3. Collaboration with international peers in evaluating applications in different R&D measures is general practice in Estonia. For example, the applications of the main research financing instruments –personal and institutional research grants – are first assessed by international peers, and then by panel of Estonian scientists with final decision made by evaluation committee of renowned scientists (ERC 2016b). Presently, there are no industry representatives in this evaluation process.
4. The research collaboration between private sector and cooperation with international researchers is facilitated through number of different financing measures. The measures aimed at increasing collaboration with private sector include competence centres, regional competence centres, clusters, innovation and development vouchers; an applied research program smart specialization growth areas etc. (described in more details below in sections on funding mechanisms for collaboration between public and private researchers and on PPIs etc). International collaboration is described in more detail in the sub-chapter on “International cooperation”.

### Trends in public expenditures on agricultural R&D

1. Estonian gross domestic expenditure on R&D (GERD) grew rapidly in the 2000s, starting from 37 million euros in 2000 and increasing ten times in ten years peaking with 384 million in 2011 and decreasing to 326 million in 2013 (OECD, 2015). Fast growth can be partially attributed to the very low level of expenditure on R&D in the beginning of this period. Estonian GERD, as a percentage of GDP, was just 0.6% in 2000, and while the expenditure grew at higher rate than OECD or EU28 average, it remained below OECD and EU28 averages (Figure 7.13). The significant spike of R&D investments in 2010-2012 was caused by onetime large investment in oil shale industry (Statistics Estonia, 2015b). With those investments, GERD briefly reached 2.33% of GDP, comparable to OECD average and slightly above the EU average, with decline in 2012 and 2013 it decreased to 1.74% just below the EU28 average.

**Figure 7.13. Gross domestic expenditure on R&D as a percentage of GDP**

Source: OECD (2015)

1. Estonia has set the target to increase R&D investments to 3% of GDP in 2020 (Government Office, 2014). Estonia 2020 estimates that this would mean quadrupling of R&D spending compared to 2009 (Government Office, 2014). The target for 2015 was 2% of GDP. In 2014 the indicator decreased to 1.44% of GDP (Statistics Estonia, 2016). Therefore, it is likely that the target for 2020 will not be met.
2. Estonia started the 2000s with very low level of government expenditure on agricultural R&D that as a share of value added was much lower than the share for all the economic activities or in Northern European countries. Onwards from the rapid growth in 2002, the agricultural research intensity in Estonia was above the research intensity for the whole economy (Figure 7.14) with government expenditure on R&D as a share of value-added reaching 2.5% for agriculture and 0.92% for all activities in 2013. The reason for such an increase in research intensity was that expenditure grew at considerably higher rate than agricultural GDP. With rapid increase in agricultural R&D intensity in the 2000s, by the end of the decade, it reached a level comparable to Denmark and Finland (Figures 7.14 and 7.15), in which the general trend for agricultural R&D intensity was downward in the end of 2000s.

**Figure 7.14. Government expenditure on R&D as a share of value-added. Government expenditure of agriculture R&D as a share of value-added in selected countries.**

Source: OECD Research and Development Statistics, 2015, OECD National Accounts, 2015.

**Figure 7.15. Government expenditure on R&D as a share of value-added, 2000-14**

Source: OECD Research and Development Statistics, 2015, OECD National Accounts, 2015 and ASTI, IFPRI 2014 for Argentina, Brazil, Chile, China, Colombia and South Africa.

1. With the increase of expenditure on agriculture R&D, by 2014 Estonia was among the countries characterised by relatively high share of budget expenditures on agriculture R&D (figure 7.16). The public expenditure in agricultural R&D in real terms increased by 9.7% from 2004-06 to 2012-14, one of the highest growth among the OECD countries in the last decade (figure 7.17).

**Figure 7.16. Share of budget expenditures on agriculture R&D as a percentage of GVA**

Note: 2002 instead of 2000 for Estonia

Source: OECD Research and Development Statistics, 2015, OECD National Accounts, 2015 and ASTI, IFPRI 2014 for Argentina, Brazil, Chile, China, Colombia and South Africa.

**Figure 7.17. Percentage change in real expenditure in agricultural R&D, 1984-86 to 2012-14**

Source: OECD Research and Development Statistics, 2015; ASTI (Agricultural Science and Technology Indicators) IFPRI, 2014.

1. The expenditures on agricultural sciences in non-profit institutional sectors increased on slower pace than in other sciences. While there have been strong fluctuations in expenditures in some years, the relative importance of agricultural sciences in expenditures in non-profit institutional sectors has been on downward slope. In 2000, agricultural sciences accounted for 9.6% of R&D expenditures in higher education and 15.3% in government sector, but by 2013, their share had decreased to 4.2% in higher education and 5.8% in government sector (figure 7.18).

**Figure 7.18. Agricultural sciences R&D expenditures in non-profit institutional sectors**

Source: Statistics Estonia 2016.

### Share of institutional versus project- or programme-based funding

1. The growing concern in Estonian R&D system is extremely high share of project-based funding. Estimates from 2014 indicate that around 80% of funding was project based (HTM 2014). Over 90% of research funding in all public universities was project based, while some R&D institutes are 100% project funded raising concerns for long-term strategic planning and sustainability of R&D institutions (Ukrainski et al., 2015b). The main funding measures- institutional funding, personal research grants, competence centres, agricultural applied research projects are all both project based and competitive (see table 7.5.) Baseline funding is main non-competitive instrument, however, its share in the total funding of R&D institutions was relatively small in 2005- 2013, remaining between 4%-6% in most of the institutions (MER, ERC 2014).
2. On the basis of the suggestions from RDC, MER and governments coalition policy agreement there are plans for considerable change in the financing instruments, including for considerable increase of the share of baseline funding in order to achieve more stability in research funding (MER 2015d). The aim is to achieve ratio 50:50 between the institutional funding and personal research grants (project based) and baseline funding (the three main funding measures). As in 2016 the baseline funding was increased by 50%, the ratio of institutional funding and personal research grants to baseline funding changed to 73:27 (in 2015 it was 80:20) (Koppel 2016).

### Share of basic versus applied R&D

1. As Estonian GERD increased, the growth was highest in expenditures on experimental development and on applied research. Most of experimental development expenditures occurred in business enterprise sector. The share of basic research expenditures in domestic expenditures in Estonia declined (figure 7.19). Universities are the central actors in carrying out basic research and in Estonia. Their share in basic research continued to increase with higher education sector accounting for 77% of basic research expenditures while the share of government sector slowly decreased over a decade.

**Figure 7.19. Estonian R&D expenditure by research type (left). Share of basic research performed in the higher education and government sectors in expenditures on basic research in Estonia (right)**

Source: Statistics Estonia (2016).

The estimates on the share of different type research of research in enterprises whose main field of activity is agriculture, forestry and fisheries are only available for 2007, 2008 and 2011. In 2007, the share of basic research in intramural expenditures of enterprises in agriculture, forestry and fisheries was 1.2%; share of applied research 1.8% and share of experimental developments among the enterprises expenditures was 97%. For 2008, the share of experimental research was 100%. In 2011, the share of applied research was 7% and experimental research 93% (Statistics Estonia 2016).

### Share of public R&D funding dedicated to sustainable technologies and practices

1. Technologies for sustainable agriculture cover the whole spectrum of farming systems. All farming systems, from intensive conventional farming to organic farming, have the potential to be locally sustainable (OECD, 2001). “Sustainable growth for a resource efficient, greener and more competitive economy” is one of the priorities of Europe2020, EU's growth strategy for the decade (EC, 2012b). Promotion of innovative agricultural technologies and resource efficiency etc. are emphasised in the ERDP 2014-2020 priorities. However, as there are no single metrics suitable for measurement of sustainable technologies and practises in different projects or in measures or programmes, it is impossible to evaluate the exact share. The aims of majority of research funding instruments support overall goal of sustainable practices and technologies.

### Source of public R&D funding; change of the composition of resources changed over time

1. Figure 7.20 summarizes Estonian R&D funding in 2010-2014. In overall funding, businesses sector plays central role, followed by EU structural funding and foreign sources. The funding from state budget has been just under half of R&D funding. For example, in 2013, around 47% of total funding came from state budget (MER, 2016c).

**Figure 7.20. R&D funding in Estonia 2010-14**

Red labels- data from 2013. In 2014 research institutional supports are part of institutional supports

Source: ERC 2016b

1. Figure 7.21. shows public funding by sources without business sector. Structural funding through MER and foreign sources account for half of public funding.

**Figure 7.21. Public R&D funding in Estonia 2010- 2014 by source (%**

2010 inner circle. Red labels- data from 2013. In 2014 research infrastructure supports are part of institutional supports.

Source: ERC 2016b

1. The overall share of foreign financing in Estonia started to grow rapidly with the EU pre-accession programmes (PHARE, ISPA, SAPARD) in the beginning of 2000s. From 2000-2013 Estonia received more than 5.4 billion euros in foreign assistance (MoF, 2016). The EU structural funds have been the main source of foreign funding. In 2004-2006 Estonia received 802 million euros and in 2007-2013 3.4 billion euros from EU structural funds (EUSAE, 2015). The importance of foreign funding grew especially with the onset of recession in 2009 as those became the main source for financing public investments (Varblane 2014). From 2009, the share of foreign supports in the annual state budget has fluctuated between 11.2% and 13.8%; in 2015, one billion euros of foreign supports accounted for 11.8% of state budget expenditures (MoF, 2015a).
2. For the programming period of 2014-2020 Estonia will receive 4.4 billion euros from the five EU structural and investment funds. That includes 725.8 mil allocated to development of agricultural sector and rural areas from EAFRD, and 100.8 million euros for the fisheries and maritime sector from EMFF (EC, 2014). Estonian research and higher education will receive 359 million euros from structural funds in 2014-2020 (MER, 2016c).

### Support to knowledge infrastructure

1. General maintenance and funding of Estonian research infrastructure is addressed through variety of instruments: covering of infrastructure costs, research infrastructure roadmap, core infrastructure supports, supports to scientific collections, and research libraries (MER, 2016a).
2. The infrastructure costs of state’s R&D institutions are funded from state budget through the ministry whose governance area it belongs to. The infrastructure costs of public R&D institutions are covered from state budget through the budget of MER (Teadus- ja … 1997). Private R&D institutions cover their infrastructure costs from private sources cost, although they may receive earmarked support from state budget and local government (Masso, Ukrainski, 2008). In 2012 research infrastructure supports accounted for 5% of total government spending on R&D (ERC, 2016b). From 2013 onwards, infrastructure costs are part of institutional and personal research grants, and the previous system of covering the expenses of R&D infrastructure will be gradually changed (ERC, 2013).
3. In 2010, Estonia prepared its first research infrastructure roadmap that is used as a long-term planning tool for investment decisions (MER, 2016a). The research infrastructure roadmap contains a list of infrastructure objects of national importance that are new or require modernisation (ERC, 2016d). The list is updated in every three years. In 2014, the roadmap contained 18 objects. EMU is a partner in four objects (Natural History Archives and Information Network (NATARC); Plant Biology Infrastructure – from Molecules to Crops; National Centre for Translational and Clinical Research (SIME); Estonian Environmental Observatory) (MER, 2016a). Estonia also participates in several international research infrastructures, including in six ESFRI (European Strategy Forum on Research Infrastructures) objects (ERC, 2016d).
4. Core infrastructures refers to infrastructures belonging to the R&D institutions, and which have been established in the public interests for the purpose of pursuing research themes, and can be used by other persons on the terms and conditions established by the owner institution (MER, 2015). It includes high-class research equipment or technologies and highly qualified workforce; its main purpose is to assist researchers, R&D teams, and business sector by making its expertise and analytical resources available. The applications for the support of core infrastructures is submitted with institutional research grants (MER, 2015). In the call in 2013, the budget for core infrastructure support was 0.5 million euros (ERC, 2016d).
5. MER funds maintenance of scientific collections that have passed evaluations with approximately 0.8 million euros per year. EMU has following scientific collections: Estonian soil museum, mycological collection, botanical collections, zoological collection that are part of larger national collections (MER, 2016a).
6. EMU library is one of the six research libraries responsible for the collection, preservation and processing of scientific information, and for making such information available for public (MER, 2016a). They are financed from state budget through MER.
7. From 1990s to the mid-2000s, Estonian R&D infrastructure suffered from underinvestment. Research infrastructure has been one of the main targets of EU structural funding (Chirtsensen et al, 2012). Following the insufficient investments in previous period, in EU programming period 2007-2013 the R&D infrastructure was developed quite extensively (Ruttas-Küttim, 2014). In this period, 29.3 million euros were invested for supporting research infrastructure of national importance (MER, 2016b). On the basis of the roadmap, in the period of 2014-2020 ERC administers 30.9 million euros in support for investments plan for research infrastructures of national importance (ERC, 2016d). While present activities concerning infrastructure investments have been generally sufficient to cover the previous underinvestment, in the future the main focus has to be on ensuring the sustainability of infrastructure (Ruttas-Küttim, 2014).
8. AIS R&D infrastructure has been modernised from MRA budgetary means and EU structural and investment funds. However, the research infrastructure, laboratories and working environments for AIS institutions are partially outdated rendering them uncompetitive and unable to provide scientific support for public and private sector (MRA, 2016f). EMU provides R&D infrastructure and competence for veterinary medicine, animal breeding, food science and technologies, and plant breeding, aquaculture and rural economics. Some of the facilities for food technology and product development for meat and fish products, bakery products, beverages, nature’s and plant products; aquaculture, and experimental stations need modernisation or expansion. A project for renovation of certain EMU buildings for a food centre with necessary laboratories and facilities for research on food technologies is in progress. Research in food technologies, including food safety, and development of products with high export potential are also supported by some of the established competence centres. Bio-Competence Centre of Healthy Dairy Products, Centre of Food and Fermentation Technologies, and regional Competence Centre for Knowledge-Based Health Goods and Natural Products Research have modernised facilities. In plants breeding, ECRI has facilities and suitable test fields, however, test apparatus and laboratories are in urgent need for modernisation (MRA, 2016f).
9. The R&D infrastructure will be also addressed by a new programme – ASTRA, “Institutional development programme for R&D and higher education institutions”. In will be the largest support measure for R&D funded from EU structural funds in Estonia in the period 2014-2020. Administered by Archimedes Foundation, 122 million euros will be allocated for construction of research and teaching facilities in R&D institutions, for facilitating structural reorganising, for improvement of quality and efficiency of teaching and research quality, for modernising infrastructure, and for internationalisation, increased cooperation, including between businesses and higher education institutions by utilising R&D infrastructure and applied research (MER, 2016c).

### Trends in funding and structure of knowledge institutions

1. High dependence on EU funding is also illustrated by strong fluctuations, incl. in the budgets of R&D institutions, caused by the end of measures financed in EU programming period of 2007-2013 and delays in implementation of different programmes and measures dependant on the financing of programming period 2014-2020. For example, measures for 2014-2020 administered by EE were not fully implemented in 2015 as they were still in the process of being developed (EE, 2015).
2. Estonian University of Life-Sciences (EMU) in the main institution in Estonia carrying out agricultural research and providing higher education in agriculture. Fluctuations in EMU’s budget demonstrate some of the issues of research funding. EMU’s budget has grown from 17.3 million in 2007 to 23.3 million euros in 2015 (Figure 7.22). Government financing for teaching undergraduate and graduate students accounts for half of university’s budget, and it has been steadily increasing. Research budget, however, has been strongly fluctuating. The disbursements from structural funds and foreign contracts at the end of EU seven-year budget cycle sharply increased research budget from 7.49 million in 2011 to 11.2 million in 2012 and to 14.2 million in 2013 while decreasing back to 9.7 million in 2014 and further declining in 2015. The structural funding was mostly used for a variety of investments, incl. infrastructure investments.

**Figure 7.22. EMU budget**

A. EMU budget

B. Sources of research funding

Source: compiled on the basis of EMU (2015c)

1. One of the distinctive features of research funding in EMU is the high importance of national contracts in research budget as from 2007 to 2015 around 40% of annual research funding came from those sources. In comparison – in UT national contracts accounted for around 10% of research budget in 2014 and 2015 (UT 2016).
2. ECRI was created in 2013 by merging Jõgeva Plant Breeding Institute and Estonian Research Institute of Agriculture (ECRI, 2016). The aim of the merger was better cooperation and higher efficiency; also it allowed to cut the costs (Figure 7.23).

**Figure 7.23. ECRI Budget**

1. ECRI budget

B. Sources of funding

(2009-13 Jõgeva Plant Breeding Institute; 2014 ECRI)

Source: compiled on the basis of MRA (2016j); ECRI (2016)

1. ECRI carries out applied and basic studies for development and upgrade of agrotechnologies, for yield and quality of used varieties and agrotechnologies; on plant protection, plant health, agrochemistry, fertilisation, and agrometeorology. The institute also breeds new varieties of agricultural crops, is responsible for maintenance breeding of registered varieties and preservation of plant genetic resources, and produces and distributes certified seeds of various agricultural crops (ECRI 2015). Around half of ECRI’s revenues come from economic activities, incl. selling seeds, different contracts; from training etc. The research revenues are dominated by MRA’s applied science programmes and allocations from state budget for research infrastructure (Figure 7.23).

### Funding mechanisms to encourage increased collaboration between public and private researchers

1. Collaboration with private sector has been facilitated through several measures. Most relevant examples for cooperation of public and private researchers are the competence centres (CC). CCs are private entities established by a consortium of R&D institution and enterprises receiving public support against the joint R&D plan consisting of collaborative R&D projects focused on applied research (Arnold et al. 2008).
2. The CC programme started in 2004 and is implemented by EE. In 2004-2008, five centres received total of 11.8 million and in 2009-2015 eight centres received 57.7 million euros in public support (Pakkas, 2014). The total budget for 2015-2022 is 40 million euros and six centres have received funding for this period (EE, 2016). Three of those are part of AIS: Competence Centre of Food and Fermentation Technologies; Competence Centre on Health Technologies; Bio-Competence Centre of Healthy Dairy Products. In addition to supporting research for the development of new and high value-added products, services and technologies, the measure promotes technology transfer and mobility of researchers among research and private business organisations and provides research opportunities for graduate students (MER, 2013). From 2007-2013 CCs created 350 jobs (Pakkas, 2014). However, research jobs in CC were often part-time and in some centres, teams were fragmented across high number of part-time contributors (Arnold et al. 2008).
3. Additional measures for R&D collaboration between R&D institutions and business sector include supports for regional competence centres, clusters, innovation vouchers and development vouchers (described in more detail under the next question).
4. A separate measure has been developed to support more efficient collaboration between public sector decision makers and R&D institutions for 2014-2020. Programme RITA has been created to support socio-economical applied research based on the needs of Estonian state. 28.1 million euros will be allocated to increase the role of the state in strategic management of research and the capacity of R&D institutions in carrying out socially relevant research (MER, 2016c; ERC, 2016e). The ministries will select the topics for applied research on the basis of needs of their governance area. The applied research will be carried out by R&D institutions (ERC, 2016e).
5. Research collaboration is one of the recurrent focal points in the EU level, and in Estonia in national horizontal and sectoral strategies and plans. Horizon2020, previous EU Framework Programmes for Research, other EU programmes as well as specific programmes provide variety of measures open to researchers in private and public researchers (described also in the sub-chapter on International cooperation). Foreign contracts have been also an important source of financing.
6. In the EU 7th Framework Programme (FP7) 2007-2013, 541 Estonian participants were part of 451 successful applications receiving 88.6 million euros (Must et al 2014). EMU took part in 12 projects (in thematic areas ‘Food, agriculture and fisheries, biotechnology’ and ‘Environment’), Estonian Crop Breeding Institute in two projects. 29 successful projects with 30 participants belonged to the FP7 thematic areas ‘Food, agriculture and fisheries, biotechnology’ (6.4% of successful applications). Out of those 30 participants eight were higher and secondary education institutes; eight private for profit organisations, six public bodies, four research organisations, four other organisations. The successful application received 2.6 million euros and the success rate of applications was 25% (Must et al 2014). The eight private for profit organisations were all SMEs participating in 26.7% of all successful projects in ‘Food, agriculture and fisheries, biotechnology’. SME’s overall participation rate in successful projects was 33%, however, it varied strongly from area in area, e.g. SMEs participated in 8.7% of successful projects in area of ‘Environment’. MRA was the most active participant among the Estonian public bodies (ERA-NET projects), followed by MER (mostly research infrastructure projects). EMU was the most active Estonian participant in ‘Food, agriculture and fisheries, biotechnology*’* (Must et al 2014). Also out of three European Research Council individual grants received, one – “Stress-Induced Plant Volatiles in Biosphere-Atmosphere System*”* (2.26 million euros for 2013-2018) – was awarded to EMU’s professor Ülo Niinemets (EC, 2016).
7. As of October 2016, Estonia participated in 170 successful applications in the ongoing Horizon2020, the EU Framework Programme for Research and Innovation running from 2014 to 2020 (ERC 2016e). 15 successful applications (9% of Estonian successful applications so far) belong to the thematic section “Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy”. The successful participants included 5 private sector enterprises, 5 universities, MRA, a state agency, 2 non-profit organisations; the total amount of EU funding for those successful Estonian applicants was 2.6 mil. euros

### Share of public support to agricultural R&D funding PPPs; areas and lessons from recent experience

1. Public-private partnerships (PPPs) are collaborative mechanisms in which at least one public and one private organization share resources, knowledge, and risks in order to achieve more efficiency in the production and delivery of products and services (Hartwich et a. 2007; World Bank 2012). PPPs are increasingly used to exploit synergies between private and public research and funding, mobilise resources and help increase the responsiveness of innovation policy to the changing business needs (OECD 2013). The common partners in PPPs are research institutes, universities, extension agencies in the public sector, and producer associations, businesses, and individual producers in the private sector (World Bank 2012).
2. CCs provide an example of PPPs in Estonia. The measure is directed at cooperation in the fields of smart specialisation. The maximum share of public support for the period on 2014-2020 is 60% and 7 million euros per centre (EE, 2016). The CC programme has provided an overall positive experience for increasing R&D collaboration between private enterprises and public organisations. While the first financing period of 2004-2008 was a first learning experience for establishing common interests and long-term cooperation; the second period of 2009-2015 was characterised by the development of human resources, facilities and organisational structures; and a considerable increase in the number of private partners as well as their growing capacities and funding resources for implementing the R&D results (Pakkas, 2014). The number of private businesses participating as partners grew from 27 in 2004-2008 to 100 in 2009-2015, while their financial contribution increased from 5.8 million to 25.4 million euros (Pakkas, 2014). The programme strengthened links between universities and industry, encouraged concentration of research and educational resources to the smart specialisation growth areas, increased the research output and R&D capabilities of partners (Arnold et al. 2008). Some of the issues that arose were the bureaucracy and conflict over ownership of results (Huisman et al. 2007). The latter issue has been amplified by the fact that many employees worked part-time in university and part-time in CC. In addition, centres research output remained below the level initially expected (Arnold et al. 2008). The overall objective is that the competence centres receiving support in the period of 2015-2022 should grow strong enough to manage on their own without public supports from EE after the end of the programming period (Pakkas, 2014).
3. In addition to the competence centres programmes, EE administers a separate programme for regional competence centres since 2009. The aim of the centres is to support regional entrepreneurship and labour market development through cooperation between enterprises and R&D institutions and to create conditions for knowledge-intensive entrepreneurship outside the areas of two largest cities in order to increase regional competitiveness (EE 2016a). The maximum support per centre for 2009-2014 was 3.19 million euros and maximum share of public subsidy for an application was 85% of eligible costs (EE 2016a). Out of the six regional competence centres established since 2009, one is part on AIS. Competence Centre for Knowledge-Based Health Goods and Natural Products is a subdivision of EMU’s Institute of Agricultural and Environmental Sciences’ Polli Horticultural Research Centre. The partners include EMU, UT, Karksi local municipality and 20 private enterprises involved in food, health, cosmetics industry, biotechnology etc (PlantValor 2016). The centre provides R&D of health goods and natural products using modern, high-technology methods, including extraction of bioactive ingredients of plant origin, that are used in functional foods, eco-cosmetics, household chemicals, pharmaceuticals etc (Competence Centre … 2016).
4. Additional measures administered by EE and directed at public-private cooperation are supports on clusters, innovation vouchers and development vouchers. Enterprises, whose main activity is primary production in agriculture, have not been eligible for those supports, however those in food sector, biotechnology etc are.
5. In the cluster programme 20 clusters and 49 pre-projects for preparation for establishing a cluster received total of 10.4 million euros during the period of 2008-2012 (Mihkelson et al. 2013). The maximum share of public financing was accordingly 70% and 75% of total project costs (Klastrite arendamise … 2008). EMU is one of the partners at Estonian Waste Recycling Cluster (Jäätmete Taaskasutusklaster 2016) and in pre-project for establishing Estonian Organic cluster (Eesti Maheklaster 2016). Other projects connected AIS were pre-projects for a milk cluster, a soy cluster, and a food cluster in southern Estonia (EE, 2016d).
6. Agricultural enterprises were not eligible for subsidies under the EE implemented cluster programme. However, in the ERDP 2014-2020 ‘Cooperation’ measure provides supports to agricultural innovation clusters. The total budget for 2014-2020 is 8.4 million euros; the share of support is up to 100% of cost and maximum amount of 800 000 euros per applicant for four years (ARIB, 2016). The interest for the measure has been high: ten action plans for the total sum of 7.5 million euros were submitted in the first call in 2015. Those include three for crop production and processing clusters, two for meat production and processing and two for organic production and processing clusters; one application for horticultural production and processing; milk production and processing; and other agricultural activities each (ARIB, 2016). However, only two applications – for a milk and for a crop production and processing cluster – received financing.
7. Innovation voucher programme provides a SMEs with grants (maximum 4000 euro, maximum share of support 80%) for cooperating with a higher education institute, test laboratory, or intellectual property experts, to develop innovative solutions for development obstacles, carry out tests with new materials, gather knowledge on technologies, conduct studies in intellectual property databases etc (EE, 2016b). 884 innovation vouchers were financed with the total amount of 4.55 million euros in the period 2008-2012 (MER, 2013). At present, the data on the funded innovation vouchers does not specify the field of activity; and so it is not possible to distinguish the number of innovation vouchers connected with AIS without a separate survey.
8. Additional measure opened for the 2014-2020 period is the development voucher programme aimed at supporting cooperation between entrepreneurs and R&D institutions. Development vouchers are subsidies (maximum 20 000 EUR per voucher, maximum share of support 70% of total costs) for preliminary research, and their targets are SMEs whose development ideas need advanced professional know-how (EE, 2016c). Four enterprises out of the first 26, who received first development vouchers in 2015 (EE, 2016d), are connected with food and agricultural technologies, and vouchers are used for developing malt processing technology, food packaging designs, developing greenhouse and smart gardening technologies.
9. One previous EE measure that has been discontinued or replaced with new measures was subsidy for the employment of development staff, incl. researchers, engineers, marketing managers, designers, in enterprises (from 2008-2012 total budget of 8.2 million euros; 62 project received support; MER, 2013). The share of public financing depended on type of development staff: 70% for researcher, engineer, designer; 50% for managers (EE, 2016f).
10. In the programming period 2014-2020, Estonia has developed additional measures specifically addressing cooperation between R&D institutions and enterprises in the smart specialisation growth areas. Those include NUTIKAS, a measure for applied research in smart specialisation growth areas. The funding of 41 million euros is allocated to businesses for commissioning necessary applied research or product development projects from R&D institutions (ERC, 2016c). The self-finance rate depends on the size of enterprise. In applied research, the maximum public support for small enterprises are 70%, for medium sized enterprises it is 60% and for large enterprises 50% of eligible costs. For product development, the public support rates are accordingly 45%, 35% and 25% (SA Archimedes 2016). Another measure is NUTIPRO with 10 million euros specifically addressing large-scale projects. The programme supports R&D initiatives with large-scale impact and coordination of applied research projects and targets R&D institutions and enterprises (MER, 2016c).

### Trends in private expenditures on R&D

1. Business enterprise expenditure on R&D (BERD) as a percentage of GDP started also at a very low level (Figure 7.24) and grew at a very high rate throughout the 2000nds. However, despite the high growth rate and high fluctuation in 2011, its share in GDP is still lower than the OECD and EU28 average.

**Figure 7.24. Business enterprise expenditure on R&D (BERD) as a percentage of GDP**

Source: OECD (2015)

1. The ERC estimates for 2014 were that 90% of government funding was directed to higher education sector and government sector and 10% was used to fund R&D in private sector (business, private non-profit). 94% of expenditures of private sector are made in the private sector and just 6% is used to procure R&D services from universities and public research institutions (Koppel 2016).
2. Estonian economy is dominated by microenterprises and with low industrial concentration in most sectors, majority of firms lack capacity to finance or perform R&D. Estonian R&D system is more dependent on government than OECD or EU countries on average. However, in the last decade the importance of business enterprises in Estonian R&D has rapidly grown. The percentage of Estonian GERD financed by government and industry changed from 59% and 24% in 2000 to 47% and 42% in 2013 respectively. The growing importance of the role of businesses in Estonian R&D system can be observed also from the increasing share of expenditures made in business enterprises (Figure 7.25). In the beginning of 2000s, 22.5% of expenditures were made in businesses, while higher education counted for over the half of GERD. In a decade, the share of expenditures on R&D made in business sector doubled. There is no later data available, because agriculture, forestry and fishing enterprises have not been among those reporting R&D expenditures or the data is not published. The number of enterprises reporting R&D expenditures to Statistics Estonia is small. For example, the overall number of enterprises reporting R&D investments in 2012 was just 259 (Mürk, Kalvet 2015). There were no enterprises whose main activity was agriculture, forestry and fisheries. Among the enterprises making R&D investments 50 largest enterprises made 85% of R&D investments (Varblane, Ukrainski 2016). Out of 259 enterprises, 111 enterprises (43%) were manufacturing enterprises, followed by enterprises specialised on professional, scientific and technical activities (21%) and ICT (16%). Among the manufacturing enterprises reporting R&D expenditures, 17 enterprises were in food industry (6,5% of enterprises reporting R&D expenditures) (Mürk, Kalvet 2015).

**Figure 7.25. Estonian GERD financing by source (left) and by sector of performance (right)**

Source: Statistics Estonia (2016)

1. The statistical estimates on Estonian R&D expenditures in business enterprises sector for enterprises in the field of agriculture, forestry and fishing is available only for some years. In 2007 and 2008 intramural expenditure of agriculture, forestry and fishing enterprises accounted for less than 1% of total expenditures in business enterprise sector.

### Public incentives to private investment in agricultural R&D, and their target

1. Different tax incentives are common instruments for encouraging R&D investments. Most commonly used R&D tax incentives aim at reducing corporate income tax liability of the company incurring R&D expenses, and labour tax incentives (Staehr, 2010). Estonia does not employ tax incentives specifically directed at R&D. Since 2000, Estonia has implemented policy that all reinvested business profits are exempted from taxation. Business profits are taxed when they are distributed (e.g. as dividends) or transferred abroad (Sepp, Wrobel, 2011). This is not specifically aimed at R&D investments. On the negative side, businesses have an option to just accumulate profits and not to reinvest these, i.e. there is no incentive to invest in R&D as opposed to any other investment opportunity that may provide faster profits (Staehr, 2010).There are also no specific labour tax incentives. In 2010 the share of direct funding (government funding through grants, contract, and loans; as opposed to indirect funding though tax incentives) in BERD was 100% (OECD, 2012).
2. In Estonia, main incentives for private investments in R&D are different research grants and supports for innovation. Smart specialisation growth areas are prioritised in innovation support measures (e.g. competence centres, applied research in smart specialisation growth areas, applied research in smart specialisation growth areas etc).

### Extent to which public procurement and other ‘pull mechanisms” are used to fund research; priority areas targeted through this type of support

1. Estonian innovation policy has so far used mostly supply-side policy instruments (Romanainen et al 2014b). The main of focus of RDI policy has been on strengthening the systemic linkages by focusing on supply-side measures, like R&D infrastructure, support to CCs and centres of excellence and provision of R&D grants. (Lember, Kalvet 2014). The previous Estonian RDI strategy Knowledge-based Estonia 2007-2013 (MER, 2007) emphasised that state must be “a role a model and a competent innovation consumer, whose procurements significantly emphasise innovativeness, quality and good design”, and the need for public procurements to be more diversified, and importance of the participation of enterprise offering innovative products and services. The importance of public sector as “a smart customer, ensuring that in public procurements as much freedom as possible is left for offering innovation solutions“ is also one of the principles for development of information society expressed in Estonian Information Society Strategy 2013 (MEAC, 2006) as well as follow-up strategy Digital Agenda 2020 (MEAC, 2013b). However, those ideas have been mostly left unimplemented and public procurements have not been systematically used for facilitating innovation (Lember, Kalvet, 2012). While systemic public procurement of innovation has been gaining attention, so far the public procurement has been successfully applied in ICT and moderately in defence sector (Lember, Kalvet 2014). There are also some examples of innovation procurement initiatives supporting usage of local energy resources, waste collection; however, these mostly reflect the impact of EU-level policies (Roolaht 2012). A feasibility study for smart procurement ordered by MEAC, recommended focusing on e-government (ICT), e-health (ICT and health technologies) and construction (efficient use of resources) as there is already sufficient competence, readiness and knowledge in those sector for stimulating demand (Eljas-Taal, 2014).
2. Estonian public procurements are registered in Public Procurement Registry. However, the registry does not distinguish whether the procurement was innovative or not, and this makes it impossible to track procurement of innovation (Romanainen et al 2014b).
3. In order to address the procurement issue, a separate support measure for smart procurement to support innovation has been planned for the period 2014-2020, and will be managed by EE. The budget for measure is 20 million euros, with maximum of 500,000 euro per application and 50% of self-financing (EE, 2016e). The measure is targeted to public sector organising tenders and to enterprises offering innovative solutions. The aim is to improve the public sectors’ ability for procuring innovative solutions as well as to support enterprises’ abilities to develop new products and services (EE, 2016e).
4. Agricultural pull-mechanisms reward successful innovations *ex post* andpush mechanisms fund potential innovations *ex ante* (OECD 2013)*.* The push mechanisms, such as research grants, tax credit on R&D, or direct inputs from funder, support research input, while pull mechanisms, such as innovation prizes, reward research output tax credits on sales, or patent buyouts, reward successful research output (Rietzke, 2015). The present AIS funding mechanisms in Estonia are typical push mechanisms in form of research and innovation grants.

### Mechanisms of producers associations, industry, private sector or NGOs to raise funds for R&D and innovation

1. At present, there are no examples of unique mechanisms or levies used by private sector, industry or associations for raising funds for agricultural R&D and innovation.

## Knowledge flows (markets, networks and adoption)

*Intellectual property rights (IPRs), knowledge networks, and knowledge markets are of growing importance in fostering innovation. Reinforcing linkages across participants in the AIS (researchers, educators, extension services, farmers, industry, NGOs, consumers and others) can help match the supply of research to demand, facilitate technology transfer, and increase the impact of public and private investments. Partnerships can also facilitate multi-disciplinary approaches that can generate innovative solutions to some problems.*

### Policy regarding access to knowledge

1. Public access to scientific information is not a new phenomenon in Estonia. E.g., the majority of Estonian scientific journals have been *de facto* open to the public since the electronic versions of articles emerged more than 10 years ago. Research libraries have actively promoted open-access ideology by organizing traditional workshops and information days in the framework of the international Open Access Week.
2. Estonia is following the concept of the European Research Area (ERA) that was renewed in 2012. One of the priorities of the concept is to ensure open access to knowledge, optimal knowledge circulation and transfer through the application of digital ERA. The underlying principle is to make research data, created or obtained by public funding publicly accessible. Plans related to the creation, preservation and dissemination are becoming an integral part of research projects (ERC, 2015c).
3. Estonia is preparing policy recommendations on open science, which is aimed at creating a common framework for handling open science in Estonia. The document will define the strategic objectives until 2025, setting separate objectives for scientific publications and research data:

* Open access to scientific publications: Research community knows and accepts the principles of open science and open access. Scientific articles published with the help of national funding are freely accessible to the public one year after their first publication at the latest, whereas at least half of the articles become immediately and permanently available. All publicly funded scientific journals and scientific journals published in Estonia adhere to the principles of open access and a free content license.
* Open access to research data: Research community knows and accepts the principles of open science and open access. Research data resulting from nationally supported research is freely accessible and reusable. Research data is stored in trusted and open repositories and are made available as soon as possible. (ERC, 2015c)

1. Farmers are granted free access to the research information on the website of the Estonian Agricultural and Rural Advisory Service (www.pikk.ee). This page has gathered agriculture-related applied research reports, collections of national variety tests, publications, articles, presentations, dissertations, defended theses and project descriptions issued by different agriculture-related R&D institutions.

### Public availability of government agencies’ information that is useful for innovation; availability and international sharing of results of public R&D

1. From 2013 onwards, a prerequisite for receiving competitive research funding (institutional research funding (IRF) and a personal research funding (PRF) is open access. Both IRF and PRF allow to cover the article processing charges of the open-access articles form the grant budget, but this practice is so far not very widely spread (ERC, 2015c).
2. In the last decade Estonian scientists have published articles in more than 4,200 different journals, 355 of which (8%) are the so-called gold open access[[16]](#footnote-17). As of the end of 2015, Estonian scientific publishers issued 46 peer-reviewed scientific journals and nearly three quarters of them are de facto gold open access. Out of the 11 Estonian scientific journals, which are listed in the Thomson Reuters Web of Science, nine are open access journals. Only part of the Estonian open-access journals have clearly defined copyright ownership and licensing conditions, and not all them are properly reflected in the DOAJ list and SHERPA/ROMEO register. (ERC, 2015c).
3. However, the status of research data has not been legally regulated. MEAC has compiled the first nation-wide policy document "The Green Paper on Open Data". However, in this document the topics related to research data remain in the background. Infrastructure for the preservation and making scientific data available have already been or are still being created, including objects of the Estonian research infrastructures roadmap „Natural History Archives and Information Network (NATARC)“, Estonian Language Resource Centre, Estonian Biocentre, Estonian e-Repository and Conservation of Collections (ERC, 2015c).
4. In 2014, Estonia joined the international consortium DataCite under the research infrastructures roadmap initiative. The consortium DataCite Estonia, which has the right to assign unique scientific data identifiers (DOI), was launched at the beginning of 2015. DataCite ensures the visibility and usability of the high-quality research resources created by affiliated research institutions. To date, a number of professional interfaces have been worked out and more than 500 thousand of data sets in Estonia have been allocated a DOI identifier, most of them via the biodiversity database PlutoF and research infrastructure roadmap NATARC. The Estonian State and the national research institutions are actively collaborating with a number of pan-European research infrastructures, including BBMRI, EATRIS, ELIXIR, CLARIN, the European Social Survey, GBIR, etc. (ERC, 2015).
5. In order to preserve biodiversity and promote sustainable agricultural production, genetic resources of agricultural crops are collected and preserved. From 1999, Estonia has participated in the European Cooperative Programme for Plant Genetic Resources (ECPGR) as a full member (European Cooperative Programme for Plant Genetic Resources, MRA, 2009). In Estonia genetic resources of agricultural crops are collected and preserved by:

• Gene bank of the Estonian Crop Research Institute that collects and preserves the genetic resources of cereals, legumes, oil crops, grasses and legumes, as well as vegetable genetic resources outside their natural habitat (seeds in ex situ gene bank). 2800 accessions of 57 species are deposited in the gene bank;

* Department of Biotechnology of the ECRI deals with the collection of different potato and horticultural plant varieties and breeds and the conservation of their genetic resources as meristem plants in test tubes (in vitro). The collection includes 490 potato and 118 horticultural and decorative plant accessions;
* Polli Horticultural Research Centre of the EMU collects and preserves genetic diversity and cultivar resources of fruit and berry crops of Estonian origin. The collection includes 1,145 items of 17 plant species, including 136 varieties bred in Estonia;
* UT’s Botanical Gardens preserve medicinal herbs, aromatic and ornamental plants in ex situ collections. The collection holds 387 varieties of ornamental plants originating from Estonia, and 55 species of medicinal plants and herbs;
* Department of Gene Technology of the TTU studies and describes plant material using molecular biology techniques.
* NGO Maadjas – collects, preserves and exchanges threatened native breeds, plant seeds and plant material.

### Rules governing intellectual property rights (IPRs); handling of IPRs by public research

1. In case of IPR in the Estonian agricultural and food sector, we can talk about industrial property: the rights to patent protected inventions, useful models, trademarks, the use of geographical indications and new plant varieties.
2. The above-mentioned industrial ownership rights are regulated by such laws as Legal Regulation of Industrial Property Act, Trade Marks Act, Patents Act, Utility Models Act, Geographical Indication Protection Act, Competition Act, Plant Propagation and Plant Variety Rights Act. The most important treaties are the Paris Convention for the Protection of Industrial Property (1883), the TRIPS Agreement, and the European Patent Convention (1973). Estonia has also joined the Madrid Agreement Concerning the International Registration of Marks Protocol (1989) and the Hague Agreement Concerning the International Registration of Industrial Designs (1925) (Hanson et al., 2015).
3. Protection documents valid in Estonia are patent certificate for invention and trademark registration certificate for utility model or geographical indication.
4. The Estonian Patent Office (EPO) is a government agency that operates in the area of government of the Ministry of Justice and provides legal protection to patents, trademarks, utility models, industrial designs, geographical indications and topology of microswitches (EPO, 2016). The Estonian Intellectual Property and Technology Transfer Centre (EIPTTC) is foundation that offers wide variety of intellectual property (IP) and technology transfer support services, e.g. does IP studies, advises enterprises on IP issues, provides training and education. EIPTTC conducts research on a variety of patent related issues, supports trademark and design search, and helps the entrepreneurs to make right decisions in the development and creation of IP in their enterprise (EIPTTC, 2016). In addition, patent attorneys also provide legal services in the field of industrial property.
5. There are two important issues concerning IPR. First, IPR are valid only for a given time. A registered trademark is valid for 10 years, a patent and a utility model for 20 years and the protection of geographical indications is perpetual. Another important principle of IPR is its territoriality. This means that a patent registered in Estonia does not confer any rights in other countries (Hanson et al, 2015).
6. In 1994-2013, the proportion of registered patent and utility model applications in the agricultural sector (mainly patents in plant breeding) comprised 3.1% and in the food sector 2.9% of the total number of applications submitted in Estonia.
7. According to Patent Co-operation Treaty (PCT) statistics in 2006-2011, the number of global patent applications from the Estonian agricultural sector was 31, accounting for a very small fraction (0.0177%, Figure 7.26 right) of the total PCT patent applications. However, the PCT patent applications in agriculture comprised 12% of Estonia's total patent applications, and agricultural science patents 1.7% of the total patent applications of Estonia (Figure 7.26, left). These figures are significantly higher than the OECD average, and in the cross-country comparison, Estonia holds the sixth position.

Figure 7.26. Agricultural patent applications filed under the Patent Co-operation Treaty (PCT) in agriculture, 2006-11. (Left: Agricultural specialisation (using fractional counts, country receives partial count for co-inventions; Right: Share of countries in total agriculture patents, 2006-11).

Source:OECD Patent Database, January 2014.

1. The total number of agricultural patents developed in cooperation with foreign partners was 15 in 2006-2011, accounting for 0.039% of the total world agricultural joint patents (Figure 7.27, right). Joint agricultural patents submitted comprised 13.8% of the national total joint patents, whereas none of the patents was science patent (Figure 7.27, left). These figures were significantly below the OECD average.

**Figure 7.27. Agriculture patents with a foreign co-inventor filed under the Patent Co-operation Treaty (PCT), 2006-11 (Left: Co-operation in agriculture; Right: Contribution to world agricultural patents).**

Source: OECD Patent Database, January 2014.

1. There are several reasons why the number of patents in Estonia is comparatively low:

* Holding a patent requires large investments from the patent holder over a long period of time.
* After patenting, the patent holder has to see to the issues of marketing and selling (commercialization), but the research community lacks adequate experience and knowledge, as well as the human, time and financial resources.
* The patent value of an invention is changing. The present trend is that inventions are immediately geared to production and, for example, high-tech inventions are patented.

1. In summary, it can be said that, although the number of Estonian agricultural patent applications is modest, both in the EPO and PCT calculations, an IPR system is at place in Estonia and, with reference to a stable political environment, has a positive effect on the country’s economic growth. This is confirmed by the change in the Intellectual Property Protection Index (IPPI) (Figure 7.28) over time. In ten past years, the Estonian IPPI has increased, and is equivalent to the average of the OECD countries and slightly higher than the average of EU28 countries.

**Figure 7.28. Intellectual Property Protection**

Source: World Economic Forum, The Global Competitiveness Report 2015-2016.

*Plant breeding and IPR*

1. Estonia became a member of the International Union for the Protection of New Varieties of Plants (UPOV), which offers strengthened protection and improves the plant breeders’ ability to recover for their initial costs of variety breeding and development, and generate the funds necessary for further re-investment in this activity by signing the UPOV Convention 1991 Act in 2000 (UPOV, 2016). Although the Plant Variety Protection Index (PVPI) of Estonia is not very high, it reflects the positive correlation between IPR and innovation performance (Figure 7.29).

**Figure 7.29. Plant Variety Protection Index**

Source: Campi and Nuvolari (2013)

1. The history of plant breeding in Estonia dates back to the 1850-ies. Estonian plant variety protection system was introduced in 1994. Plant breeding is regulated by the Plant Propagation and Plant Variety Rights Act and the Regulation of the MRA on the list of plant species the seed and propagating material of protected varieties of which may be grown in small quantities. The principles for the EU plant variety protection system are laid down in Council Regulation (EC) No. 2100/94 on Community plant variety rights, and the EU and the EC Regulation No. 1768/95 on agricultural exemption (Rand et al., 2010).
2. The areas of research and breeding in organisations engaged in plant breeding include agricultural, vegetable, fruit and berry plant breeding, seed growing, basic and applied research in plant breeding, development, innovation, increasing the gene pool, collection and preservation of plant genetic resources. ECRI specialises in crop studies, including plant breeding and the Polli Horticultural Research Centre, Organic Centre and the Rõhu Experimental Centre of EMU are engaged in horticulture (berries, fruits, gardening, vegetables and their breeding).
3. MRA has financed a variety of plant breeding projects in the framework of national applied R&D programme. “Plant Breeding Programme 2009-2019” was launched to coordinate plant breeding and related research. Its aim is to breed varieties that will enhance the competitiveness of plant production and agricultural processing industry (MRA, 2008).
4. A bred, discovered and created by applying different breeding techniques, new plant variety is intellectual property. New plant varieties, their development and discovery are protected by the plant variety protection rights. Plant Propagation and Plant Variety Protection Act regulates plant variety protection. Plant varieties entered in the Register of Plant Variety Rights, with the exception of vines and tree crops remain under protection for 25 years, which remain under protection for 30 years (EIPTTC, 2016).
5. The registration and cataloguing of varieties, and organising their protection are the responsibilities of the Agricultural Board (AB, 2016). The AB keeps record of the varieties under protection in a catalogue, which is publicly available on the AB website (Rand et al, 2010).
6. In recent years, most of the requests for the registration and protection of IPR have concerned rapeseed, winter wheat and barley varieties. In 2012-2014, the number of applications submitted to AB for the registration and protection of IPR has decreased as compared to the previous years. Due to the good market price of protein-rich staple feedstocks and an increase of the role of leguminous crops in agricultural support schemes related to the environment interest, the registration of bean varieties has increased as well (AB, 2015).
7. Today the number of protected varieties in Estonia exceeds 160, including a variety of crops (wheat, oats, canola varieties, etc.) and fruit and berry crops (apple, plum, black currant, etc. varieties EIPTTC, 2016).
8. Crop genetic resources are collected and stored by ECRI, Polli Horticultural Research Centre of EMU, Botanical Gardens of UT and the Institute of Gene Technology of TUT. The programme “Genetic Resources for Food and Agriculture 2014-2020” has been introduced, which main objective is to grant the collection, preservation and study of the plant genetic resources for food and agriculture of Estonian origin as a fund for variety and species diversity, creating thereby conditions for sustainable development. The key activities for achieving the objectives include the collection of genetic resources of agricultural and food crops, management of collections, international cooperation, promotion, organisation and communication (MRA, 2008). In 2007-2013, the cultivation of the local winter rye variety “Sangaste” was supported under the ERDP measure “Support for the cultivation of local varieties”. For the period 2014-2020, the list of supported varieties has been supplemented with a variety of crop, fruit and berry varieties.

*Animal Breeding*

1. Interest in Estonian native breed cultivation increased in the 19th century. The objective of farm animal breeding is to systematically improve livestock performance and increase the genetic value of farm animals and the maintenance or improvement of their economically beneficial characteristics.
2. At present there are five breeds in Estonia that are in the status of an endangered breed. The endangered farm animal breeds include the Estonian native cattle, Estonian native horse, Tori horse, Estonian heavy draught horse and Estonian quail, whose preservation in terms of cultural heritage and genetic diversity is important. In 2007-2013, Estonian native cattle, Estonian native horse, Tori horse and Estonian heavy draught horse were supported from the ERDP measure “Support for the endangered livestock”. In 2014-2020, Estonian quail is also supported, because it is the only ingenious breed of poultry bred in Estonia (Kaeramaa, 2014).
3. The state promotes animal breeding via breeding associations and farm animal performance testing. There are 15 recognized breeding societies and associations in Estonia that deal with horse, cattle, sheep, poultry and pig breeding. Six of these associations are engaged in the preservation of endangered breeds. Estonian Livestock Performance Recording Ltd records, collects and analyses livestock performance data and performs genetic evaluations of farm animals.

*Food Science and IPR*

1. Competence Centres (CCs) and universities stand out in the promotion of innovation in the field of food science. The best known innovation is related to the lactic acid bacteria Lactobacillus fermentum ME-3 (Helluse bakter), which was discovered by a research team from the UT in 1995 and that has been issued a patent in the USA, Russia and 24 European countries. As this strain of bacterium has a favourable effect on human health, the bacteria were added to functional dairy products and they were thereby included in the daily menu of customers. Today Lactobacillus fermentum ME-3 has found application in medicine (being one of the main components in a food supplement).
2. Another strain of bacterium Lactobacillus plantarum TENSIA® discovered by the researchers of the Bio-Competence Centre of Healthy Dairy Products and the UT is also worth mentioning. This strain has been granted a patent in Estonia, in 11 countries in Europe and Russia. The discovered strain of L. plantarum TENSIA® was applied in the creation of a new functional food product, Südamejuust (English translation: heart cheese) Harmony™ (BioCC, 2016). In case of Südamejuust, problems have been encountered with the European Food Safety Authority not substantiating the health claims attributed to the cheese.
3. As to agriculture, Lactobacillus plantarum E-98 NCIMB 30236 has been isolated and developed in Bio-Competence Centre of Healthy Dairy Products (BioCC) in the cooperation of industrial partner STARTER ST. The silage additive can be used to ensilage grasses with a wide range of dry matter content. Lactobacillus plantarum E-98 NCIMB 30236 has been registered as a silage additive in the EU register of Feed Additives and which has been issued by commission implementing regulation (EU) No 1111/2011 (Official Journal of the European Union L 287/30) (BioCC, 2016).

### Mechanisms developed to encourage co-operation between actors, including farmers

1. Following the restoration of independence, Estonia has been successful in improving the quality and volume of academic research. Since the accession of Estonia to the EU, a significant part of the EU Structural Funds was invested in the development of R&D infrastructure, human resources and entrepreneurship. This has helped to create a modern and attractive environment for research, increase research community, ensure a new academic generation and enhance international cooperation (MER, 2014). At the same time, the disproportionate division of the R&D expenditure between basic and applied research and technological development, as well as low level of cooperation between science and entrepreneurship has not facilitated economically viable end results of research projects (i.e. demand-side approach).
2. Two successful forms of cooperation can be noted in agriculture and food industry (MRA, 2016g):

* Competence Centre (CC) programme was launched in 2004 as an Enterprise Foundation (EE) programme to create a link between research and entrepreneurship. CCs are established in important research areas between academia, industry and the public sector. CCs are involved in multiple activities: pooling of knowledge, creation of new knowledge by performing different types of research, training and dissemination of knowledge and networking. CCs are research institutions oriented at long-term cooperation between academia, industry and the public sector (to some extent this can be regarded as PPP). CC-s are involved in developing new technologies and top scientists are looking for new and innovative technological solutions in the partners’ key areas. CCs have developed during their operation by doing research and publishing scientific articles. Some CCs are also related to innovation clusters and the European Innovation Partnerships (EIP). Enterprise Estonia supports the CCs till 2020 and thereafter, the CCs have to support themselves. The sustainability of the CCs may cause problems as CCs do not have enough projects to cover their fixed costs. There are also shortcomings in inter-ministerial coordination regarding the monitoring of the CCs, and the stability of their funding. Applied research can be financed from two sources – contributions from businesses or support from various support measures, which require recipient’s own contributions. Corporate-funded R&D activities are primarily carried out in global corporate groups. It is very difficult for the domestically owned companies to get funding. It has been suggested that that an outreaching CC-wide organization could offer CCs marketing and generic services. At present, there are six CC-s in Estonia, including the following in the agricultural and food sector:

 Competence Centre of Food and Fermentation Technologies[[17]](#footnote-18), deals mainly with the research into the metabolism of lactic acid bacteria and yeasts;

 Bio-Competence Centre of Healthy Dairy Products, LLC[[18]](#footnote-19), which has five partners. The activities of the centre encompass the whole chain, from cattle breeding, nutrition and dairy technology to functional food. In cooperation with universities (EMÜ, TU), the CC has registered 14 patents;

 Competence Centre on Health Technologies[[19]](#footnote-20), is a research and technology organisation focused on applied research and product development in personalised medicine, drug development and reproductive medicine, both in human and veterinary medicine. The consortium consists of 30 members;

 PlantValor – Competence Centre for Knowledge-Based Health Goods and Natural Products18 is a network, which activities in the first phase involve 23 contractual partners both from food and other sectors. The Centre focuses on the sustainable use of plant material in food and non-food products by raising the quality, functionality and storing properties of the plant material. PlantValor is a regional competence centre that belongs to the Estonian University of Life Sciences.

* Centre of Excellence ENVIRON is a consortium led by the EMU, which is a centre of excellence for the adaptation to environmental changes, bringing together five leading research groups from the EMU, UT and TUT. The interdisciplinary research goal of ENVIRON is to study how plants and ecosystems cope with and adjust to stress induced by changing environmental conditions. The research results form a basis for the sustainable management of Estonian natural resources in forestry crop production in view of the future climate.

1. The application of innovation vouchers has contributed to enhanced cooperation between academia (including EMU) and industry in terms of putting knowledge and know-how into practice. Innovation vouchers give SMEs access to research and innovation services. They can, in collaboration with universities, testing laboratories and intellectual property experts, develop innovative solutions to obstacles, experiment with new materials, gathering information on innovative technologies, research intellectual property databases, etc. The innovation voucher scheme has proved successful and as an independent measure received relatively positive feedback. However, only in a few cases has this short-term and small-scale scheme developed into a longer-term and more systematic collaboration with universities (Lember et al., 2015).
2. At the same time, poor dissemination of information on RDI and the lack of cooperation between different partners in promoting innovation have been identified as a threat to the sustainability of Estonian agriculture. The low level of cooperation can be explained by the low capacity of SMEs to do R&D activities and the lack of multidisciplinary solutions offered to agricultural producers and processors, resulting in insufficient awareness of the entire production chain. Although the cooperation between R&D organizations is comparatively good, the entire sectoral potential, however, is not taken advantage of. In 2014-2020, support measures are introduced to improve the situation (MRA, 2015a). The fact that cooperation between academia and enterprises concerning conducting studies and trials (product development), making analysis, as well as providing consulting services and training is project based, may also cause problems (EMU, 2010). For various reasons, a lot of enterprises in Estonian agricultural and food sector are still not ready to invest into R&D and product development activities, because there are a few domestic capital-based industries in Estonia and as to product development, branches of foreign companies predominantly get their R&D support from the parent company (Vooremäe, 2011).

### Further developed plans of knowledge flows between AIS actors

1. For the most part, innovation in agriculture and food sector is implemented through the II pillar of the CAP – ERDP 2014-2020. Innovation is an important priority of the ERDP 2014-2020. One of its objectives – functioning cooperation, timely research and development, and knowledge transfer between the manufacturer, the processor, the adviser and the researcher – is also aimed at innovation. The main focus is targeted at enhancing cooperation between the various parties (producers, consultants, academics), and thus applying the research results into practice. Three measures in particular contribute to this objective – knowledge transfer and information (budget of 12 million euros), extension services (budget of 8.6 million euros) and cooperation (budget of 18.7 million euros) (MRA, 2015a).
2. Measure ‘Knowledge transfer and information actions’ offers support for:

* the organisation of one- or multi-day training sessions allowing the acquisition and upgrading of vocational, occupational or professional knowledge and skills, as well as retraining;
* the organisation of presentation and outreach activities introducing already existing innovative technologies and modes of action or production. Outreach activities arranged to inform target groups on the topics relevant to their work are also supported;
* the organisation of visits to enterprises and running workshops aimed at learning from each other's experience. Visits to companies focus, first and foremost, on raising environmental awareness, on the production methods or technologies in agriculture and forestry, the diversification of agricultural production, agricultural enterprises involved in short supply chains, innovative entrepreneurship opportunities and technologies and improving the ecological resilience of forests;
* the publication of training and teaching materials;
* the organisation of long-term training programs (duration of up to 7 years), which combines all the above-mentioned activities;
* The following long-term training programmes are being prepared: plant cultivation, livestock farming, organic farming, horticulture, food safety, cooperation and agricultural policy (MRA, 2015a).

1. Extension services contribute to individual counselling (measure ‘Advisory services, farm management and farm relief services’), including sustainable plant protection and aspects of household or enterprise management (cooperation, governance of business processes or technologies, management structure, market analyses or work organization analysis, strategic planning and consultancy on the introduction of amendments). Small-scale farmers are offered mentoring regarding day-to-day decision-making or launching entrepreneurship and agricultural production activities. Mentoring is a long-term process and the service is offered by advisors (counsellors) or experienced farmers. Mentoring is mainly offered to improve the effectiveness in economic, agricultural and environmental performance. However, the service has links to all fields of guidance. A farmer may be supported with extension services for up to 3,000 euros per calendar year (MRA, 2015a).
2. ‘Co-operation’ measure: co-operation approaches among different actors in the union agriculture sector, forestry sector and food chain and other actors that contribute to achieving the objectives and priorities of rural development policy, including producer groups, cooperatives and inter-branch organisations. The measure supports:

* innovation clusters. The clusters that have drawn up a up to four-year action plan for the development of new products, processes or technology, small business collaboration, diversification of agricultural activities, collaboration between small-scale enterprises, etc. are supported. The action plan includes the division of tasks concerning fostering innovation between the members of the cluster. The activities in the action plan must be geared towards the practical needs of the company;
* short supply chains and the development local markets. Such promotion activities as the organisation and participation in exhibitions, competitions, fairs, investments into equipment necessary for product distribution, IT solutions, etc. are supported;
* development of new products, practices, processes and technologies. The aim is to support individual projects, which promote cooperation and develop innovation, especially in the agriculture, food and forestry sector, and solve specific producer- and processor-related problems (MRA, 2015a).

1. Investment measures, which support different technologies, contribute to innovation indirectly, thereby facilitating the introduction of different innovation into production. Innovation is at the heart of LEADER ‘local development’ measure (CLLD), which endeavours to foster finding innovative solutions and their application. To this end, the local action groups should also describe innovative elements in the strategies they are compiling. In addition to that, LEADER programme focuses on how to take advantage of local resources for the development of local business and social environment, with an emphasis on innovative solutions (MRA, 2015a).

### How are farmers and local stakeholders associated in the priority setting, implementation and funding of research and advisory services

1. There are several advisory bodies in the field of agriculture:

* Council of Agricultural Sciences. The Council is commissioned by MRA. The Council is responsible for (1) advising the minister in the RDI activities within the scope of the MRA, and (2) monitoring the implementation of the RDI measures funded by the MRA, and, on the basis of the results, proposing improvements to the Minister. The Council comprises of representatives of the MRA, R&D organizations, farmers’ associations and agricultural producers and farmers (MRA, 2016g).
* Advisory Board of EMU. The EMU Advisory Board links the university and society, whose members are appointed by the Council of the EMU, after hearing the opinion of the University. The term of office of the members of the Advisory Board is three years (EMU, 2016a).
* Knowledge Transfer Council. The Knowledge Transfer Council monitors the development of agricultural sciences, knowledge transfer and advisory services with regard to the producers’ needs and environmental awareness. In addition, the Council keeps account of the implementation of the priorities of relevant national strategy documents and makes recommendations concerning the implementation of the ERDP 2014-2020 knowledge transfer and consultancy measures. The Council comprises of representatives of the MRA and MER, farmers’ associations and agricultural producers and farmers (MRA, 2016g).
* The Consultative Council of the Rural Development Foundation (RDF). The RDF Consultative Council is an advisory body to the RDF in all matters concerning advisory services. The representatives of farmers, processors of agricultural products, research and development institutions and the MRA belong to the Council. The activities of the Council are aimed at attaining the overall objective of advisory services, which is to develop sustainable agricultural and rural economy in Estonia through counselling (RDF, 2016).

### Main institutions or organisations involved, their geographical coverage and level of action; cooperation mechanisms or organisations to develop sustainable practices, and their effectiveness

1. Institutions providing learning opportunities in education offer co-ordinated and regulated transfer of knowledge and promotion. These institutions may be universities, vocational schools, or associations of producers. In 2007-2013, universities and R&D organizations that had their own knowledge and/or technology transfer departments played a more active role in role in knowledge production and they were highly ranked among the farmers and food processors (EMU, 2012). EMU, ARC (mainly environmental-education training) and ECRI have been among the most active trainers in agriculture and the food industry and they have provided training all over Estonia. Producer associations have also served a significant role in knowledge transfer by arranging training activities on the municipal and county levels.
2. The farmers, who applied for support from the sub-measures of the ERDP 2007-13 Environmentally friendly management, Organic farming and Maintenance of semi-natural habitats, were obliged, dependent on the sub-measure, to go through a certain number of seminars and training sessions regarding the environmentally friendly management, organic production or maintenance of semi-natural habitats, respectively. The same system is followed in period ERDP 2014-20. Since horticultural enterprises were added to the list of businesses eligible for support for environmentally friendly management, it is compulsory for the horticultural entrepreneurs to undergo a training on environmentally friendly management as well.
3. The Advisory Centre of RDF also provides co-ordinated and regulated counselling to farmers and rural entrepreneurs. Local contact points of the Advisory Centre are located in every county of Estonia, which give free information on the consultancy services on offer. It is also possible to order advisory services. In 2014-2020, the development is concentrating on the easy access to counselling by the target group, relevance of advice given, orientation to the latest scientific information and high quality of service throughout Estonia. Policy measures help to enhance cooperation with other advisory centre contact points, the coordinating advisory centre, R&D organizations and the various professional associations in order to ensure the information flow between producer-researcher and researcher-producer. The supported extension services would like to take on advisers who are competent in climate change and innovation promotion. Supported advice is better accessible by the farmers. Farmers/producers pay 10% of the fee for most counselling services (animal and plant production, organic farming, etc.). The support for the advice on management issues and drawing up a business plan amounts to 50% (RDF, 2016).

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| **Box 7.1. The main events in the development of the advisory system**   * 1991 The creation of the first advisory services system the Estonian Farmers' Federation (EFF) under the aegis of a project. The system joined the advisory stations of regional farmers’ unions, two training centres working at the farmers’ unions (Harju and Viljandi) and the Jäneda Training and Advisory Centre. * 1993 A cooperation project between the Estonian Farmers' Federation and the Danish Agricultural Advisory Centre was launched to build up an advisory system based on the farmers’ associations. The structure of the advisory system was interfaced to the structure of the farmers’ union. * 1994 Advisory unions were formed in Viljandi, Tartu, Jõgeva and Järva Counties with the financial support of the mentorship programmes run by the German and Estonian Ministries of Agriculture. The Estonian Association of Rural Consultants (Eesti Konsulentide Ühing) was founded. * 1995 National advisory program was launched. The foundation for the contractual relationships between the consultant and the producer was laid. * 1997 On the initiative of the Estonian Association of Rural Consultants, a system for the certification of the rural consultants was worked out, which aimed to raise the quality of advice through checking the qualifications of the consultants. * 2000 "Rural Development and Agricultural Market Regulation Act" that defined such terms as "advisory support", "advisory support recipient" and "requirements set for the adviser and their attestation" were adopted. * 2002 By means of public procurement information dissemination centres are opened at the farmers’ or producers' associations at the county-levels. Rural Development Foundation (RDF) took over the information dissemination programme. * 2003 The Estonian Chamber of Agriculture and Commerce took over from RDF the activities related to the dissemination of information (Agricultural Knowledge and Information System (AKIS)). * 2005 The Minister recognizes recognises the need to have advisory centres in every county, and they are used simultaneously used as information dissemination centres. The Estonian Chamber of Agriculture and Commerce is held responsible for the harmonisation of the level of information offered by the advisory centres, for the training and continuing education of advisers and for the producers' needs analysis. Regular training and development activities are introduced. * 2006 The Ministry of Agriculture in collaboration with the Estonian Chamber of Agriculture and Commerce start the reorganisation of the agricultural advisory system to simplify administration and make the provision of extension services more flexible. * 2007 The Agricultural and Rural Advisory Coordinating Centre was established, which has the role of a mediator between the Ministry of Agriculture and the advisory centres and the advisers. * 2010 RDF will once again take over the coordination of the advisory services. * 2011 RDF, recognized advisory centres, producer and professional organizations signed an Agreement for Joint Activity. The parties joined the agreement voluntarily to combine their efforts to ensure the availability of high-quality advice and act towards the common goal – the establishment of a nationwide single extension system by the year 2013. The organisations acceded to the agreement of joint action devised and adopted the Estonian agriculture and forestry advisory system development plan for 2012–2020, together with the Action Plan for 2012–2020. Agreement for Joint Activity ceased activity in 2013. * 2014 The Ministry of Agriculture procured a public tender to find a provider of extension services * 2015 The Ministry of Agriculture and Rural Development Foundation signed an authorization agreement, which establishes that the Rural Development Foundation will offer subsidised agricultural and rural economic advisory services in 2015-2021. The estimated volume of extension services for the entire duration of the programme (2015-2021) is 1000 advisory cases and 1800 unique clients per year. The value of the contract is 8.2 million. Provision of advisory services is financed from the budget of the ERDP 2014-2020. Advisory Council is an integral part of the RDF. The Advisory Council comprises of the representatives of farming and processing industry, research and development institutions and the Ministry of Rural Affairs. The activities of the Advisory Council are targeted at attaining the objectives of extension services, i.e. to develop sustainable agriculture and rural economy in Estonia. The structure of the advisory services is made up of the Estonian Agricultural and Rural Advisory Service (coordinator of the advisory system, support structure for advisers and mentors) and local contact points in every county, where free-of-charge information on the advisory services and the range, nature and price list of the advisory products can be found. It is also possible to order advisory services or counselling.   Source: Advisory service of Rural Development Foundation , http://www.pikk.ee/. |

1. Farmers are not satisfied with the current advisory system. First, because the advisory is being continuously reformed and the advisory system has changed hands several times, which has hindered the natural development of the system. Decisions and activities concerning the advisory system are not discussed with the producers. Large-scale farmers are also not satisfied with the quality of the advice received. The advisers are not proactive in offering their services. The partnership between the advisors, farmers, and scientists is inadequate or poor. The advisers make use of the information and know-how generated at the university, but they are not formally associated with the university. Farmers believe that the advisory system should be a link between the researcher and the producer. Today, the role of a mediator is not fulfilled. Large-scale producers approach the researchers directly. In addition, constructive advice can be obtained from the production inputs vendors. This, however, can sometimes lead to the unnecessary costs on the part of the producer and place an excessive burden on the environment because there is a lack of impartial counsellors, whose advice would not depend on their own commercial interests. Larger cooperatives have their own advisers who try to generate more interest in the producers towards counselling.
2. The advisers are not satisfied with the advisory system mapped out for the period 2014-2020 either. Counselling requires good partnership and cooperation, but the existing advisory system does not generate sufficient motivation. The advisers are not motivated to develop their skills and knowledge. They are not interested in giving advice. Advisers deal with regular customers and do not promote the services of the advisory system.
3. In addition, RDF local advisory centres, start-ups and operating businesses may get free advice from the municipal development centres. The centres share information on funding opportunities and entrepreneurship. Novice entrepreneurs are supported in starting the business and compiling a business plan. Municipal development centre operate as a network in every county. Enterprise Estonia coordinates the activities of the network (CDCIS, 2016).
4. As a supporting structure NRN also contributes to the knowledge and innovation transfer (RERC, 2016), including the promotion of innovation in agriculture. In order to achieve the set objectives, NRN, inter alia, collects, aggregates and disseminates best practices, examples of networking and innovative approaches, helps to find partners (also for innovation clusters) and participates in the work of the Innovation Network. In 2012 NRN issued the publication “Take notice of innovative agriculture”[[20]](#footnote-21). In the framework of the activities of the NRN, the Agricultural Innovation Network (AIN) was established in 2014. AIN fosters co-operation between the manufacturer, processor, adviser and researcher and the implementation of the European Innovation Partnership (EIP) work groups’ action plans and information clusters. The latter encourages a faster and wider transposition of innovative solutions into practice and contributes to the product, market, operational, organizational or personnel innovation is rural economy.

*Particular attention can usefully be paid to training, extension and advisory services that can facilitate the transfer and successful adoption of innovation. The potential benefits of innovations are only realised if effectively implemented. Given the very large number of often small farmers, extension services have a particularly important role to play. They are critical to facilitate farmers’ access to technology and knowledge and contribute to facilitate farmers’ effective participation in innovation networks and ability to formulate their specific demands. It is also important to support the diffusion of innovation in small agri-food firms.*

### Availability and use of extension services; provision by the public sector; targeting to specific groups of farmers, specific areas; payment for the service

1. One of the most important roles of the advisory services is the communication of research information to the manufacturer. In this area, the activities of the R&D organisations overlap, in part, with those of the advisory system, but the R&D organisations have no direct links with advisory centres. Estonia is characterised by an open extension service market and today there is a wide range of extension services operating in Estonia, whereas each of them has their own peculiarities and target audience. Part of the research activities are carried out as direct contacts between companies and researchers and are not reflected in the statistics concerning agriculture (Vooremäe, 2011).
2. During the period 2008-2014, 2695 farmers used the supported extension service (CAP, second-pillar measure 114, Advisory services). The number of agricultural holdings totalled 19,186 in 2013, and a total of 5.4 million euros was spent on extension. Entrepreneurs covered 25% of the sum, the rest constituted the EAFRD and the State’s contribution. Advice on financial economics ranked the first (Figure 7.29), but the advice was used to to compile investment applications. In 2014−2020 emphasis is placed on principal production-related counselling.

Figure 7.29. Supported advisory service capacity (hours), 2008−2015

Source: Estonian Agricultural Registers and Information Board (ARIB).

1. The reasons why so few farmers have used advisory services may be rooted in the bureaucracy related to the advisory support and the cost of the products and services. The farmer was paid the advisory support only after having received the service and submitting the corresponding application for payment to the paying agency (ARIB). Receiving the advisory support after the service could be beyond the reach of micro-scale farmersThe reasons why so few farmers have used advisory services may be rooted in the bureaucracy related to the advisory support and the cost of the products and services. The farmer was paid the advisory support only after having received the service and submitting the corresponding application for payment to the paying agency (ARIB). Receiving the advisory support after the service could be beyond the reach of micro-scale farmers.
2. Dependent on their financial situation, the farmers and food processors may self-finance their training, or receive training from input salesmen, raw material suppliers or purchasing agents, whose activities are tied to the economic interests, or have received free training as supported from other EU and Estonia State’s funds. Farmers and food processors have been offered regulated training, dissemination and outreach activities in the framework of the second pillar of the CAP, ERDP 2007-2013 measure 111 (Vocational training and information actions). This training measure was based on the initiative of trainers and sector representative organizations, thus it was a supply-side measure. The implementation of the measure were necessary and essential for the farmers and food processors, because they were generally free of charge or the training was otherwise not offered (EMU, 2012). With support from EAFRD and from the State budget in the amount of 3.4 million euros. Courses that were not part of regular agricultural education programmes were organised in 2008-2015. The provided training courses were primarily meant for agricultural producers (Figure 7.30). Training was provided in other areas (mainly in livestock farming, organic farming, food hygiene and crop-production (EMU, 2013b).

Figure 7.30. The ERDP 2007-13 measure 111 Training and information output indicators, 2008-15. Number of participants in training.

Source: ARIB.

1. In 2010-2015, on an average 18% of all persons employed in agriculture attended the training courses organized in the framework of measure 111, while the average participation rate in food industry was around 3% of the employed sector (Figure 7.31).

**Figure 7.31. The ERDP 2007−2013 measure 111 Training and information output indicators, 2008-2015. Participant’ share of the employed sector, %.**

Source: EMU, 2016c.

### Provision of training programmes

1. In 2007 to 2013, no nationwide long-term training programmes in knowledge transfer to farmers and food processors were offered. For a more detailed survey please see Chapter 5 Capacity building and public services (education and skills policy).

### Support to the access to the private extension services

1. Estonia does not support consultation options for private market advisors.

### Programmes to promote on farm and firm adoption of innovations and knowledge transfer; targeting of specific types of innovations, such as environmentally friendly technologies and practices

1. Strategic development documents handle innovation at a more general level. However, in a sense the implementation of the ERDP 2007-2013 within the II pillar of the CAP can be regarded as a programme fostering innovation. This programme offered training and advice for the agri-food industry sector. The investment measures of the same programme contributed to innovation, by supporting a variety of technologies, enabling, thereby, the application of a variety of innovations into production or the production of new products.
2. Three investment measures in the same programme contributed directly to the implementation of environmentally friendly technologies (EMU, 2015a):

* ‘Bioenergy production’ which the farmers used to purchase machinery of equipment for energy crops cultivation, biomass procession and bio-energy production. Preference was given to applications which results promised a bigger effect on CO2 emissions decrease. In the framework of this project, 79 enterprises invested 17 million euros in bioenergy production.
* ‘Processing of agricultural products’ that food processors and feed manufacturers used mainly for the purchase, installation and application of equipment and technology necessary in food and feed production. In the application evaluation, higher scores were given for investment in environmental sustainability and innovativeness of the investment. 95 companies used the support to invest in total 88 million euros into industry, almost all of whom launched a new product to market or introduced a new technology.
* ‘Livestock facilities’. Preference was given to applicants who planned a bioenergy installation next to the livestock housing. These measures helped 269 farmers to invest 182 million euros in livestock facilities.

1. With the help of the EE, the new programme period 2014-2020 saw the launch of a business development program (in 2015) that supports the elaborated development of the enterprise, better planning of activities, introduction of innovation and product development. Each company participating in the programme will launch new products and services that guarantee higher profitability to the market. At least three-year-old enterprises with at least eight employees specialising in industrial or smart specialisation areas are eligible for the grant. The budget of the programme amounts to 73 million euros, which, in addition to the State is co-financed by ERDF (EE, 2016).

### Mechanisms for commercialization of innovation

1. The knowledge transfer mechanisms described in the sub-section of the present chapter may be considered the mechanisms for commercialization of innovation, e.g. research information and provision access to it, promotion of cooperation and networking among innovation stakeholders.

## International co-operation

*International co-operation on agricultural research and development offers universal benefits. While this is generally true given the public good nature of many innovations in agriculture, it is particularly the case where global challenges are being confronted (as in the case of responding to climate change) and when initial investments are exceptionally high. The benefits of international co-operation for national systems stem from the specialisation it allows and from international spill-overs. In countries with limited research capacity, scarce resources could then focus on better taking into account local specificities.*

### Mechanisms used to encourage cross-country, international collaboration

1. Funding the participation in international collaborative research projects is one of the aims of Applied R&D Programme of MRA for 2015-2021. In the period from 2015-2021, 2.6 million euros (27.2% of the programme budget) is planned for international collaboration. The programme states that international research collaboration, and participation in international networks, gives researchers (and through that to agricultural producers, food processors and advisors) experience and knowledge necessary for professional development and improves research quality (MRA, 2016h). The priorities are related to the international networks and co-operation that MRA is participating in: Joint Programming Activities, ERA-Net projects, and other international collaborative research projects. The programme is expected to result in increased number of international research projects and scientific publications in which Estonian researchers contribute to (MRA, 2016h).
2. Estonia’s Agriculture, Food and Fisheries Science and Knowledge Transfer Development Plan for the Period 2015-2021 aims to increase the number of international collaborative research projects by 50% by 2021 compared to 2014. It is expected that in 2021, there are 45 such projects, four in veterinary medicine, three in food technology and safety, three in animal husbandry and breeding, 18 in crop production and plant breeding, eight in horticulture (berries, fruits, landscape gardening), six in fisheries and aquaculture, and three in rural economics (MRA, 2016f).
3. In some cases, if the research topic requires cross-country comparisons (e.g. in case of agricultural and rural development policy analyses), the call for tenders for some specific applied research project (e.g. by the Standing Committee of Rural Affairs of the Parliament of Estonia), encourage international collaboration by giving additional evaluation points if foreign experts are involved in the project.

### Policy efforts regarding exchange of staff, domestically or internationally

1. Estonia participates in the EURAXESS, which is an EU wide network for researchers in motion, providing a one-stop shop for researchers seeking to advance their careers and personal development by moving to other countries (ERC, 2015c). International staff exchange is facilitated via various programmes: Nordplus (Nordic Council of Ministers’ programme in the area of lifelong learning), Erasmus, DoRA (programme for internationalisation of doctoral studies), Kristjan Jaak (scholarships for studying abroad for up to 12 months), Mobilitas Pluss.
2. ERC is providing mobility grants and scholarships through various programmes for Estonian and foreign researchers to carry out research in a new research environment to exchange experience, expand their co-operation networks and obtain new skills. (ERC, 2016c):

* In the period 2008-2015, research mobility programme Mobilitas was in place. In the period 2016-2021, it is replaced by Mobilitas Pluss mobility funding - the programme budget is 35.4 million euros, 83.5% of which is covered by the ERDF. The programme aims to (ERC, 2016c):
  + improve the international visibility of Estonian research, business and higher education and Estonia’s attractiveness as a destination country for study and research;
  + strengthen the international competitiveness of Estonian researchers and research performing organisations, including companies;
  + support opportunities for Estonian R&D institutions and companies to collaborate with transnational research organisations and networks, including through synergy with Horizon 2020 actions;
  + expand international collaboration and professional development opportunities for the state, R&D institutions, higher education institutions, companies, students and academic staff by improving intersectoral and international mobility and cooperation (opportunities).
* Mobility support schemes in Mobilitas Pluss programme include (ERC, 2016c):
  + Mobilitas Pluss post-doctoral grant– support for researchers coming to Estonia to carry out their research projects. The support is aimed at researchers who have defended their doctoral degrees abroad;
  + Returning researcher grant– support for researchers who have carried out their post-doctoral research (or research at least at the same level) abroad and return to continue their research in Estonia;
  + Top researcher grant– support for top researchers who come from abroad to work in an Estonian R&D institution and to establish their own research group;
  + Support for study visits and training abroad– support for researchers working at Estonian R&D institutions to participate in trainings and study-visits.
* Post-doctoral research funding - the aim of postdoctoral grant is to support researchers with Estonian PhD degree or those with equivalent international research qualifications to continue their independent research careers in strong collaborative research groups for up to two years. Researcher who has received his/her doctorate in Estonia cannot apply for a postdoctoral project at an Estonian R&D institution (ERC, 2016c).
* From 2010-2015, postdoctoral research grant programme ERMOS (Estonian Research Mobility Scheme) was applied with a purpose to develop and diversify Estonian research potential through the mobility of researchers and exchange of experience. Moreover, thereby to activate international exchange of knowledge and support the development of careers of young researchers. With the grants, financed with a support of the FP7 Marie Curie COFUND the “People” Programme the researchers were enabled to blend in with the academic world by continuing the work in their field of science in Estonian research and development institution (ERC, 2016c).

1. Development plans of several Estonian research organisations (e.g. EMU) foresee that members of academic staff should participate in teaching, research or training in research institutions abroad. Also, international competition for academic posts is fostered (EMU, 2016b).
2. The start-up research grant conditions of ERC require that a principal investigator of a start-up research grant can be a researcher who has been awarded the first doctorate or equivalent qualification at least two years before and no more than seven years prior to the call, and has completed postdoctoral studies (preferably abroad) after receiving their doctorate or equivalent qualification. The evaluation committee may, where justified, consider eligible a person who has not completed postdoctoral studies but has comparable research experience (preferably abroad) (ERC, 2016c). Therefore, the experience of working as a postdoctoral researcher in international research groups (for which the mobility programme is available) can be regarded as a precondition of starting up an individual researcher career.

### Barriers to the international flow of knowledge through private mechanisms

1. There are no major formal barriers for international flow of knowledge through private mechanisms. The main limiting factor is capacity of various actors. There is little interest among research capable foreign-owned firms in commissioning development projects in Estonia. Estonian research system is focusing on public financing, therefore making insufficient effort in attracting private sector money (MIRRIS 3). Some foreign-owned companies in agri-food sector, that have strong research, development, and innovation departments at their headquarters are not interested in developing respective activities and departments in Estonia. Therefore, the Estonian daughter companies remain innovation importers.

### International and regional networks Estonia is involved in

1. MRA is participating in co-ordination of several international scientific networks and joint initiatives with an aim to increase the competitiveness of Estonian researchers and develop respective scientific disciplines in Estonia (MRA, 2015b).
2. MRA represents Estonia in the following joint programming initiatives of the EU (MRA, 2015b):

* The Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI). This was the first initiative in the framework of which a project was launched in 2012;
* The Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans);
* The Joint Programming Initiative on Antimicrobial Resistance (JPIAMR).

1. MRA participates in the following ERA-Net co-operation networks (MRA, 2015b):

* ERA-Net SUSFOOD – SUStainable FOOD production and consumption;
* ERA-Net CORE Organic – Coordination of European Transnational Research in Organic Food and Farming Systems;
* ERA-Net C-IPM – Coordinated Intergated Pest Management in Europe;
* ERA-Net Plus Climate Smart Agriculture: adaption of agricultural systems in Europe;
* ERA-Net Cofund FACCE SURPLUS – Sustainable and Resilient agriculture for food and non-food systems;
* ERA-Net COFASP – Cooperation in Fisheries, Aquaculture and Seafood Processing;
* ERA-Net Cofund – European Research area on Sustainable Animal Production Systems

1. MRA is planning to join the co-operation networks working on animal production, cereals production and Marine Biotechnology ERA-Net (MRA, 2015b).
2. MRA is also participating in the following co-operations (MRA, 2015b):

* Euphresco - a network of organisations funding research projects and coordinating national research in the phytosanitary area.
* BONUS, the joint Baltic Sea research and development programme for years 2010-2017;
* OECD Co-operative Research Programme on Biological Resource Management for Sustainable Agricultural Systems;
* Interreg Central Baltic Programme 2014-2020.

1. Estonia is participating also in COST – European Cooperation in Science and Technology (ERC, 2015c).
2. ERC is a member of European Science Foundation. Estonia has its representatives at European Science Foundation (ERC, 2015c).
3. ERC is one of the founders of Science Europe, which promotes the collective interests of the Research Funding and Research Performing Organisations of Europe (ERC, 2015c).
4. Estonia has a liaison office of research and development in Brussels. This office is responsible for promotion of Estonian research and development activities, participating in the Informal Group of RTD Liaison Offices, provides support for Estonian research and development organisations in organizing events, and provides opportunities of internships in Brussels (ERC, 2015c).
5. Estonia is relatively well represented in various EU research co-operation networks by ERC and MRA. The limiting factor is the limited and uneven capacity of research organisations and research groups, and ability of scientists to actively participate and benefit from these networks. Therefore, in some disciplines the opportunities are successfully utilized while in other areas the ministry or research council level cooperation has not yet lead to research organisation, research group or scientist level co-operation.
6. The extent of international scientific collaboration is measured by percentage of documents with collaborating authors in foreign country (Figure 7.32). In Estonia, in the period of 2007-2012, 48.1% of all scientific output, and 47.3% of agricultural science output was published in collaboration with authors from foreign country. OECD averages for all scientific output and agricultural science output were 45.6% and 50.8%, respectively. Therefore, the average of all scientific output in Estonia exceeds the OECD average by 2.5 percentage points, while the average of agricultural science output is 3.5 percentage points below the OECD average. In Scandinavian countries and the Netherlands, the proportion of all science and agricultural science output with collaborating countries in foreign countries was larger, In Latvia and Canada, this proportion was similar to the Estonian one, in Poland and Czech Republic, it was markedly lower. Considering that Estonia is a relatively small country with limited research capacity, expansion of co-operation with research organisations in Scandinavian and other Northern European countries could be the first priority of international co-operation for Estonian research organisations. For agricultural research, the advantages of Scandinavian and Northern European countries in terms of scientific co-operation lies in advanced culture of cross-border scientific collaboration in these countries, similar climate zones and agricultural production practices, and similarities in institutions and culture. As was mentioned above, fostering international collaboration is one of the priorities of the applied R&D Programme of MRA for 2015-2021, and Estonia’s Agriculture, Food and Fisheries Science and Knowledge Transfer Development Plan for the Period 2015-2021.

Figure 7.32 International collaboration, 2007-12. Percentage of documents with collaborating authors in foreign country

Source: Provided by OECD

Note: Agricultural science include Scopus journal classifications: agronomy and crop science, animal science and zoology, aquatic science, ecology/evolution/behavior systematics, forestry, horticulture, insect science, plant science and soil science, and miscellaneous agriculture/biological sciences. "Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved March 19, 2014, from http://www.scimagojr.com"

1. Estonia has a very small share in the world’s agri-food publications, remaining below 0.2% (Figure 7.33). However, similarly to other BRIICS countries, a slight increase can be observed in share of Estonia’s agri-food publications the over the past 16 years, while OECD countries are suffering a decline.

Figure 7.33. Evolution of scientific output and impact in agricultural sciences, 1996−2012. Percentage of world output

Source: SCImago. (2014). SJR — SCImago Journal & Country Rank. Retrieved March 13, 2014, from <http://www.scimagojr.com>

Figure 7.33. Evolution of scientific output and impact in agricultural sciences, 1996−2012. Percentage of world output (smaller scale)

Source: SCImago. (2014). SJR — SCImago Journal & Country Rank. Retrieved March 13, 2014, from <http://www.scimagojr.com>

1. Based on the Scopus journal classifications Estonia’s share of agricultural science publications amounted to 13.7% of all science publications and agricultural publications to 12.8% of all agricultural publications in 2007-2012, which is significantly higher than the BRIICS and OECD countries’ average (Figure 7.34a). However, in a global context and given the small size of Estonia, Estonia’s agricultural science publications and agricultural publications make up a very small share (Figure 7.34b).

**Figure 7.34. Agriculture publications, 2007-2012**

Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved March 19, 2014, from http://www.scimagojr.com

Note: Agricultural science include Scopus journal classifications: agronomy and crop science, animal science and zoology, aquatic science, ecology/evolution/behavior systematics, forestry, horticulture, insect science, plant science and soil science, and miscellaneous agriculture/biological sciences.

1. Scopus journal classifications show that Estonia’s share of agricultural science citations amounted to 14.0% of all science citations and agricultural citations to 13.1% of all agricultural citations in 2007-2012, which is significantly higher than the BRIICS and OECD countries’ average (Figure 7.35a). However, in view of the small size of Estonia, Estonia’s agricultural science citations and agricultural citations make up a very small share from the global perspective (0.9%, Figure 7.35b).

Figure 7.35. Agriculture citations, 2007-2012. Percentage of total scientific citations

Source: SCImago. (2007). SJR — SCImago Journal & Country Rank. Retrieved March 19, 2014, from http://www.scimagojr.com

Note: Agricultural science include Scopus journal classifications: agronomy and crop science, animal science and zoology, aquatic science, ecology/evolution/behavior systematics, forestry, horticulture, insect science, plant science and soil science, and miscellaneous agriculture/biological sciences.

## Overall performance

### Main outcomes of research programmes; outcomes in the area of sustainable use of resources

### Assessment of the impact of R&D on the sector in terms of income and productivity growth, and sustainability

1. Impact of R&D activities on sector income, productivity growth and sustainability are not assessed per se. In the framework of ERDP 2007-2013, an ongoing evaluation has been done. Thus, the effectiveness of ERDP is assessed continuously.

## Summary

* Good capacity and environment to innovate, but problem of capacity among the older generation.
* All Estonian strategies are linked to EU ones.
* Innovation is an integral part of economic development strategy.
* Innovation is mentioned in many official documents but not in one coherent policy document. The same applies to agricultural innovation. Agricultural innovation strategy, as all sectoral innovation strategies, is integrated with nation-wide strategy.
* Innovation priorities have changed between 2004-14 (infrastructure, capacity, entrepreneurship) and 2014-20 (horizontal innovation, risk and acceptance).
* General innovation policies are evaluated according to EU rules. The same can be said for agricultural innovation.
* Efforts are made to communicate with the public about innovation and science.
* Some ERDP measures concern innovation adoption, and stackeholders discussion (innovation clusters).
* The economic, environmental and social impacts of innovation are evaluated in the ERDP.
* Agricultural research intensity has increased since 2000, in particular higher education (linked to the restructuring of institutes). Funding is variable, partly due to dependence on foreign/EU sources and programming periods. High share of project-based funding. Many investments have been made in research infrastructure, which needed upgrading.
* There are programmes and efforts to encourage international cooperation.
* Estonia is following the concept of the European Research Area (ERA) that was renewed in 2012. One of the priorities of the concept is to ensure open access to knowledge, optimal knowledge circulation and transfer through the application of digital ERA. Farmers are granted free access to the research information on the website of the Estonian Agricultural and Rural Advisory Service.
* The number of Estonian agricultural patent applications is modest, both in the EPO and PCT calculations, an IPR system is at place in Estonia and, with reference to a stable political environment, has a positive effect on the country’s economic growth. This is confirmed by the change in the Intellectual Property Protection Index (IPPI) over time. In ten past years, the Estonian IPPI has increased, and is equivalent to the average of the OECD countries and slightly higher than the average of EU28 countries.
* Competence centres are an important source of innovation, but funding leads them to frequently focus on international issues as opposed to topics that can benefit the domestic agriculture sector.
* A number of different Estonia advisory services are operating in the counselling services market. Part of the research activities carried out through direct contacts between the companies and researchers. The Advisory Centre of RDF also provides co-ordinated and regulated counselling to farmers and rural entrepreneurs. But farmers are not satisfied with the current advisory system.
* Depending on the financial possibilities, the farmers and food processors have self-financed their training, or received training from input salesmen, raw material suppliers or purchasing agents, whose activities are tied to their economic interests, or have received free training supported from the EU or national funds.
* The Estonian innovation system supports economic sectors and enterprises that the state has identified as key areas, and in terms of investments into research and development Estonia is in particular focusing on promising areas that ensure high added-value and are important for the country. In the development of strategies and setting the priorities Estonia proceeds from the Europe 2020 strategy objectives.
* The innovation policy in Estonia employs the EU smart specialization concept, which focuses on stimulating the three smart specialisation growth areas (information and communication technology (ICT), which is linked to other economic areas, health technologies and services, and resource efficiency), where the development opportunities of the companies are above the average and commitment to R&D will allow them to gain a competitive advantage.
* In recent years, demand side innovation policy has attracted a lot of attention. The demand driven innovation policy focuses on entering the new product markets and the introduction quality requirements contributing to the launch of new products. However, the domain of agriculture can be regarded as supply side, where the bulk of innovation in Estonia and in other countries in the world is facilitated by equipment and material suppliers. The involvement of the technology user in research and development activities has been rather modest and the number of patent applications relatively small.
* Innovation-related cooperation between the state, the universities and business enterprises has been more active in large-scale enterprises. The most innovative companies in Estonia are the subsidiaries of foreign companies and foreign-owned companies. However, Estonia is dominated by low-tech small and medium-sized companies, whose need for research and development activities has so far been rather limited. Corporate spending on research and development has increased the most in primary and resource-intensive production. Still, despite the almost threefold growth in the expenditures on research and development, the expenditures on agricultural research in Estonia have, however, been the lowest. The majority of the investment in agriculture, forestry and fishery constitute the acquisition of machinery and equipment necessary for higher value-added production. Food production and forestry companies are far more innovative. In their case, expenditures on new product development have prevailed.
* The priorities of Estonian rural development policy stem from the general development priorities of Europe and Estonia. The introduction of the measures covering both Estonia-wide horizontal development plans and sectoral priority areas is preceded by canvassing the strengths, weaknesses, opportunities and threats. The analysis of the EU, other national and sectoral strategic documents, the experience and results from the previous periods are also carried out.
* The supervision over the implementation of both horizontal sectoral and national strategies takes place once a year. In addition, interim and expost evaluations are also carried out to assess the efficiency of the systems, programmes, actions, measures and projects. To measure the the results, the changes as a result of the intervention and changes in the participants' performance an assessment tool – sets of indicators have been worked out.
* So far, the RDI indicators applied in Estonia have primarily been focused on the use of input and output indicators comparable to the EU that describe and analyse the dynamics of the RDI system based on the framework of EU policies and objectives. The current use of indicators has thus been of monitoring nature. The development of more detailed indicators with intervention logic is carried out in the preparation phase of the specific operational plans and programmes. However, all comparative indicators applied in the EU may not be suitable for all EU countries. Given the small size of Estonia, the indicators not in compliance with the peculiarities of Estonia include patents as too narrow an indicator, or Estonia’s place in the Innovation Union Scoreboard, which measures the R&D-based innovation, rather than the import of knowledge and its application for the benefit of the society, which is important from Estonia’s point of view.
* Time-lag between the programme outcomes and their effects, which may take years, constitutes a real problem in assessing the success of the programme. The immediate control over the programme generally ends with the outputs. The changes induced by the outputs are affected by all sorts of external factors. The longer the delay between the programme output and the impact of the achieved output, the more uncontrollable factors intervene in the chain. However, in the public sector the delayed impact is of real importance and it should be evaluated.
* The implementation of the RDI policy at the measures, regulations, indicators level has so far been based on the linear understanding that innovation begins with basic research, which is followed by applied research and by the introduction of the new practical solutions in industry and economy. A relatively limited understanding of the role of the state in RDI, which finds expression in low-intervention and high-technology centred RDI policy affecting mainly the framework conditions for the economic environment, and where general statistics on the developments in the research systems and corporate financial indicators have been applied as the main feedback mechanisms of innovation policies, have been contributing to the persistence of this linear approach in Estonia.
* The strategic framework of the innovation policy is logical, but it lacks a comprehensive model. Estonian innovation policy is characterized by the abundance of strategic documents, action plans, policies, programmes and projects, which coherence is difficult to identify. Substantive activities related to achieving the desired level of innovation call for development, including the horizontal implementation of the innovation policy in the country as a whole, risk management related to innovation introduction/purchase, cooperation between the different parties, including stakeholder involvement. Stakeholder involvement in the elaboration and implementation of innovation policy in Estonia has gained momentum, but today their involvement still lies in participation in the meetings with sectoral umbrella organizations, universities or Estonian Chamber of Commerce and Industry.

Recommendations

* Public advisory system: lack of stability prevented the development of an advisory system responding to needs.
* Need to strengthen linkages with research and farm organisations, upgrade capacity of extension officers and better target the needs.
* The counselling offered to farmers should include forward-looking and innovative features such as adaptation to climate change, introduction of innovation in the business environment, etc.

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# Annex 1. Studies and policy analyses conducted in the framework of the TIPS programme

Study 1.1. Copyright and Open Access issues in research and development activities. *Autoriõiguse ning avatud juurdepääsu (Open Access) küsimused teadus- ja arendustegevuses.* Interim Report, October, 2012.

Study 1.1 The intellectual property system and IP role in the framework of R&D of a small open economy country, comparative mapping of the situation and preliminary research. *Intellektuaalomandi (IO) süsteem ja IO roll väikeriigi T&A&I süsteemis, võrdlev situatsiooni kaardistamine ja eeluuring*. Interim report, October 2012.

Study 1.2 In-depth analysis of IP processes, testing and analysis of methodology of the survey, and formation of IP policy, strategy and regulatory recommendations for Estonia. *Intellektuaalomandi (IO) protsesside süvaanalüüs, seire metoodika testimine ja analüüs ning Eestile sobivate IO poliitikasoovituste kujundamine*. Final Report, August 2015.

Study 2.1 Comparative analysis of Estonian research funding. *Eesti teaduse rahastamise rahvusvaheline võrdlevanalüüs*. Final Report, January 2013.

Study 2.2 Monitoring Estonian research funding. *Eesti teaduse rahastamise seire*. Final Report, September 2015.

Study 2.2 The impact of decentralized competitive research funding on the financial management of universities in Estonia. *Detsentraliseeritud konkurentsipõhise teadusrahastuse mõju finantsjuhtimisele Eesti ülikoolides*. Policy Analysis, April 2014.

Study 2.3 Interaction analysis of Estonian research funding instruments. *Eesti teaduse rahastamise instrumentide koostoime analüüs.* Final Report, September 2015.

Study 2.4 Doctoral School Measure: Experiences and Recommendations for the future. *Doktorikoolide meede: senised kogemused ja ettepanekud tulevikuks*. Interim report, September 2012

Study 2.4 Efficiency of PhD studies. *Doktoriõppe tulemuslikkuse analüüs.* Final Report, April 2014

Study 3.1 Management patterns of Estonian research and development establishments. *Eesti teadus- ja arendusasutuste juhtimismustrid*. Final Report, February 2014.

Study 3.1 Management patterns of Estonian research and development establishments. Strategic management at universities. *Eesti teadus- ja arendusasutuste juhtimismustrid.* *Strateegiline juhtimine ülikoolides*. Partial Report, December 2013.

Study 3.2 Evaluation and management models for assessing the efficiency of cost-accounting and administration models of Estonian research and development establishments. *Eesti teadus- ja arendusasutuste kuluarvestuse ning tulemuslikkuse hindamise ja juhtimise praktikad.* Final Report, September 2015.

Study 3.3 Application of social accounting for universities. *Sotsiaaltulemuse arvestuse rakendamine ülikooli raamatupidamises.* Final Report, September 2015.

Study 4.1 Monitoring the cooperation experience between industry and higher education institutions. Collaborative Industrial PhD programme. *Ettevõtete ja kõrgkoolide koostöökogemuse seire. Ettevõtlusdoktorantuuri koostööprogramm*. Partial Report, February 2015.

Study 4.1 Monitoring the cooperation between enterprises and higher educational institutions. *Ettevõtete ja kõrgkoolide koostöökogemuse* *seire*. Final report, September 2015.

Study 4.2 Management the cooperation between enterprises and higher educational institutions. *Ettevõtete ja kõrgkoolide koostöö juhtimine*. Interim report – Study into the cooperation between enterprises and higher educational institutions, June 2013.

Study 4.2 Management the cooperation between enterprises and higher educational institutions. *Ettevõtete ja kõrgkoolide koostöö juhtimine.* Interim report – Study into practical training. June 2013.

Study 4.2 Peculiarities of cooperation between enterprises and higher educational institutions. *Ettevõtete ja teadusasutuste koostöö eripärad*. Final report, September 2015.

Study 4.2 Organisational base and barriers for cooperation between higher education institutions and enterprises. *Ülikoolide ja ettevõtete koostöö organisatsiooniline baas ja barjäärid*. Final report, September 2015.

Study 4.3 The role of research and development enterprises in the Estonian innovation system. *Teaduspõhiste ettevõtete roll Eesti T&A- ja innovatsioonisüsteemis*. Final report, August 2015.

Study 4.4 Spin-off enterprises and their supporting framework in Estonia. *Spin-off ettevõtted ja nende tugisüsteemid Eestis.* Final report, May, 2014.

Study 4.5 The role of regional higher education institutions in regional development. *Regionaalsete kõrgkoolide roll kohalikus arengus.* Final report, August 2015.

Study 5.1 Estonian research funding instruments and the socio-economic impact of publicly funded research in Estonian economy: a policy analysis of the challenges and opportunities of the contemporary R & D system. *Eesti teadusfinantseerimise instrumendid ja teaduse rakendatavus majanduses: poliitikaanalüüs tänase TAI süsteemi väljakutsetest ja võimalustest.* Final Report, February 2014.

Study 5.2 Relations between the Estonian research and development system and economy: case studies on the relevance of research and development and innovation policy for the real economy. *Eesti teadussüsteemi ja majanduse seosed: juhtumianalüüsid avaliku ja erasektori nõudlusele vastamisest.* Final report, September 2015.

Study 5.3 Challenges and opportunities of policy-making and governance systems of the Estonian research and development and innovation policy in 2015- 2020: non-linear innovation policies and new platforms for cooperation and coordination policy development. *Teadus- ja arendustegevuse ning innovatsioonipoliitika valitsemise väljakutsed ja võimalused 2015-2020: mittelineaarne innovatsioonipoliitika ning uued koostöö ja koordineerimise platvormid poliitikakujundamisse.* Final Report, 2015.

Study 5.4 Estonian research and development and innovation policy in international comparison: the case of small states. *Eesti rahvusvaheline positsioon teadus- ja arenduspoliitika rakendamisel.* Interim report, October 2012

Study 6.1 Possibilities and challenges of implementing the European Research Area in Estonia. *Euroopa teadusruumi rakendamise võimalused ja väljakutsed Eestis*. Final report, September 2015.

Study 6.1 Possibilities and challenges of implementing the European Research Area in Estonia. *Euroopa teadusruumi rakendamise võimalused ja väljakutsed Eestis.* Policy analysis, September 2015.

Study 6.2 Demand-side innovation policy measures in Estonia: intervention logic, measures and restrictions. *Nõudluspoolne innovatsioonipoliitika Eestis: sekkumise loogika, meetmed ja piirangud.* Final Report, January 2014.

Study 6.3 Mobility of Estonia-related researchers in Europe. *Eestiga seotud teadlaste mobiilsus Euroopa teadusruumis.* Final report, September 2015.

Study 6.4 Careers in scientists: Estonia in the international system. *Teadlase karjäär: Eesti rahvusvahelises taustsüsteemis.* Final report, July 2015.

Study 6.4 Careers in scientists: Estonia in the international system. *Teadlase karjäär: Eesti rahvusvahelises taustsüsteemis.* Interim report, September 2012.

Study 7.1 Research, development and innovation indicators in Estonian Innovation and research policy: current practice and policy recommendations. *Teaduse-arendustegevuse ja innovatsiooni indikaatorid Eesti innovatsiooni- ja teaduspoliitikas: senine praktika ja poliitikasoovitused.* Final Report, December, 2013.

Study 7.2 Evaluation of the implementation of the current research, development and innovation strategy. *Lõppeva teadus- ja arendustegevuse ning innovatsioonistrateegia täitmise hindamine.* Final report, August 2012.

Study 7.2 Opportunities and challenges of smart specialisation in the development and governance of Estonian RDI policy 2014-2020. *Nutika spetsialiseerumise võimalused ja väljakutsed Eestis TA&I poliitika kujundamisel ja juhtimisel 2014-2020.* Policy analysis, March 2014

# Annex 2. Studies Publisher in the framework of the” Innovation Studies“ series:

1. 2002 Competence Centre Programme Estonia. Feasibility Study

2. 2002 Innovation in Estonian Enterprises 1998–2000

3. 2003 Business Incubation: Review of Current Situation and Guidelines for Government Intervention in Estonia

4. 2003 Optimising the Design and Delivery of Innovation Policy in Estonia: an Evaluation of Policy Instruments for Intensifying Business Innovation

5. 2004 Access of Enterprises to Venture Financing in Estonia: Feasibility Study of Government Support Scheme

6. 2006 Evaluation of the Design and Implementation of Estonian RTDI Policy: Implications for Policy Planning

7. 2007 Innovation in Estonian Enterprises 2002–2004

8. 2007 Impact Evaluation of Spinno Programme in 2001–2006

9. 2007 Innovation Staff Recruitment Programme Feasibility Study

10. 2007 Evaluation of Estonian RTDI Policy Mix

11. 2008 *Ettevõtete tehnoloogiainvesteeringu teostatavuse analüüsi lõppraport* (Final Report of the Feasibility Study for the Industry Incentive Scheme)

12. 2008 Mid-Term Evaluation of the Competence Centre Programme

13. 2010 Estonian Biotechnology Programme. Feasibility study for an Estonian Biotechnology Programme

14. 2010 *Eesti ettevõtete uued võimalused – ärimudelid, avatud innovatsioon ja riigi valikud* (New opportunities for Estonian entrepreneurship – business models, open innovation and public choices)

15. 2011 Feasibility Study for an Estonian Materials Technology Programme

16. 2011 *Innovaatiline tegevus ettevõtetes aastatel 2006–2008* (Innovation Activities of Enterprises 2006-2008)

17. 2011 Evaluation Framework for Innovation and Enterprise Support Policies in Estonia

18. 2012 The Role of Green ICT in Enabling Smart Growth in Estonia

19. 2012 Peer-Review of the Estonian Research and Innovation System. Steady Progress Towards Knowledge Society

20. 2012 *Energiatehnoloogia programmi vahehindamine. Aruanne* (Interim report of the Programme for the Propmtion of Energy Technology)

21. 2012 *Ettevõtlus- ja innovatsioonipoliitika vahehindamine* (Mid-Term Evaluation of the Entrepreneurship and Innovation Policy)

22. 2012 *Maa kaugseire ja satelliitnavigatsioon – rakendused, kasutusvõimalused ning mõju Eestis* (Earth Observations and Satellite Navigation – applications, Use and Impact in Estonia)

23. 2014 *Teostatavusuuring innovatsioonipoliitika nõudluspoole meetmete väljatöötamiseks ja rakendamiseks Eestis* (Feasibility Study for the Development and Introduction of Demand-Side Innovation Policy Measures in Estonia)

24. 2015 *Eesti ettevõtete uuendusmeelsus ja innovatsiooni toetamise võimalused* (Innovation in Business and Innovation Support Mechanisms)

1. In the report, Estonia is compared to the OECD and EU (either EU15 or EU28), the Netherlands, Canada, Czech Republic, Denmark, Finland, Sweden, Latvia, Lithuania and Poland (if data is available). Selection of countries for comparison is based on three criteria: neighbouring countries (Latvia, Lithuania, Poland, Finland and Sweden), countries with similar farm structure (Czech Republic, Denmark), and comparable countries (in terms of size or climate) for which the OECD review on innovation, agricultural productivity and sustainability has been published (Canada and the Netherlands). [↑](#footnote-ref-2)
2. This calculation is based on farm aggregates, not on detailed information about the actual usage of fertilizers and crop protection per ha of wheat. It is evident that due to higher share of grassland in the UAA of dairy and mixed farms, the average spending on fertilizers and crop protection per ha of UAA is lower. Also, dairy and mixed farms probably have more manure that could be used for fertilizing, and therefore, the costs on mineral fertilizers could be lower. [↑](#footnote-ref-3)
3. The labour productivity indicators of food industry (value added at factor costs per emplyed person) and farms (net value added per AWU) are not directly comparable, but here it assumed that they are acceptable proxies for the current comparison. [↑](#footnote-ref-4)
4. The livestock density index measures the stock of animals (cattle, sheep, goats, equine, pigs, poultry and rabbits) converted to livestock units (LU) per ha of UAA using specific coefficients. Eurofarm LU coefficients are established by convention (originally, they were related to the animals’ feed requirements). LU are not calculated for bees and other livestock. [↑](#footnote-ref-5)
5. Field crop, dairy, beef and sheep, fruit and vegetable, non-ruminants, and mixed farms in Australia, Canada, Belgian Flanders, Estonia, Germany, Italy, Netherlands, England, and USA. [↑](#footnote-ref-6)
6. 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). (ETI, 2015) [↑](#footnote-ref-7)
7. As of 01.09.2016 no enterprises have submitted the VFB any applications for entering the market with novel food and GM food and feedstuffs. (ECCI, 2016). [↑](#footnote-ref-8)
8. Article 36 of the European Council Regulation (EC) No. 1698/2005 regards Environmentally friendly management and organic production as an agri-environment support: the payments are entitled to cover the costs incurred by the farmers and other land-owners, and compensate for the loss of their earnings due to their voluntary commitment to apply agricultural production methods that are compatible with the protection and improvement of the environment, the landscape and its features, natural resources, the soil and genetic diversity. (ARIB, 2016d) [↑](#footnote-ref-9)
9. The statistical survey “Innovation Survey of Enterprises” for the years 2008–2010 is the implementation of the European Community Innovation Survey (CIS) in Estonia. The survey is carried out in all European Union Member and candidate States simultaneously. The frame of the survey covered all enterprises with at least 10 employees in industry and selected economic activities in services. To evaluate an enterprise’s innovativeness, it was asked about its activities in 2010–2012. If an enterprise did not introduce during this period any innovations or did not engage in any innovative activities, it was considered non-innovative (Statistics Estonia, 2016). [↑](#footnote-ref-10)
10. An enterprise that, during the years under consideration, introduced a product innovation to the market or implemented a process innovation or was involved in some other innovation activity (in connection with abandoned or ongoing innovation projects; also, research and development can be the main or secondary activity of the enterprise). [↑](#footnote-ref-11)
11. Systems of innovation approach highlights the importance of systemic links between scientific research, technological change, learning and innovation. The main focus is on the functioning of the system and the complex relationships that involve a variety of organizations and institutions within the system. At the same time, the focus is shifted away from the activities of individual and isolated parties (companies and consumers) (Chaminade and Edquist, 2005). [↑](#footnote-ref-12)
12. Demand side innovation activities include support for entering to new markets, establishment of quality requirements that initiate creation of new products. Respective policy instruments include regulations, public procurement, and support of private demand. Supply side innovation activities include provision of finances and services. In this case, the policy instruments include capital support, financial instruments, and support to public sector research, training and mobility support, and grants to R&D activities in processing industry (Paltser and Reiljan, 2015). [↑](#footnote-ref-13)
13. The present programme is a third programme with the same name; it was preceded by „Agricultural Applied Research and Development“ in 2004-2008 and in 2009-2014. However, agricultural applied research has been financed by MRA and its predecessors for several decades. [↑](#footnote-ref-14)
14. The present programme is a third programme; it was preceded by „Collection and Conservation of Plant Genetic Resources for Food and Agriculture“ in 2002–2006 and in 2007–2013. [↑](#footnote-ref-15)
15. Frascati Manual classification; agricultural sciences: agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects); veterinary medicine. [↑](#footnote-ref-16)
16. Golden Open Access (Gold Open Access) means that the publication is immediately and permanently available free of charge for everyone on the publisher's website. The article publishing charge may be covered by the authors, their institutions or an organization, such as a university or a professional association or the Academy of Sciences. Most of the scientific journals in Estonia use the latter model, and the authors do not have to pay the article publishing charge to the journals. The specific conditions for the gold open access publications are determined by a specific license. Most of the open-access articles use the so-called Creative Commons licenses. It is allowed to file away such publications oneself and store the copy in the institutional (e.g. university digital archive), national (e.g. ETIS), or an international repository (e.g. arXiv, PubMed Central). [↑](#footnote-ref-17)
17. Keskuse koduleht: http://tftak.eu/et/ [↑](#footnote-ref-18)
18. Keskuse koduleht: http://tptak.ee/ [↑](#footnote-ref-19)
19. Keskuse koduleht: http://www.ccht.ee/ [↑](#footnote-ref-20)
20. Publication: <http://www.maainfo.ee/data/trykis/Notice_the_Innovative_Agriculture_eng_2013_WEB.pdf> [↑](#footnote-ref-21)