2016

Agroforum Mare Balticum

CONFERENCE PROCEEDINGS

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Agroforum 2016
Mare Balticum

Conference Proceedings

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RECTOR'S FOREWORD

The annual international agricultural forum Agroforum Mare Balticum will be held, already for the fourth time now, in Tartu, Estonia. The conference is an important meeting point for the agricultural sector's politicians and entrepreneurs, and research institutions from the Baltic sea countries and the Eastern Partnership countries, as well as global organisations such as the Food and Agriculture Organization of the United Nations, the European Commission and the Council of the Baltic Sea States. This multi-level meeting enables us to use and transfer the best available knowledge at all levels and from all geographical spheres, to discuss and find solutions to the significant challenges faced by the agricultural sector today.

The main focus of this year's forum is environmentally smart agriculture. While globally climate smart actions are being discussed, we felt that there is a need to take this concept even further and discuss the future of agriculture, taken into account the state of our environment as a whole, not just the sector's resilience to changing climatic conditions. Society's health depends on the quality of the food, and the highest quality food can be produced only by working in concordance with natural processes, ensuring healthy soils, sustainable water management, reasonable use of pesticides and use of other agricultural chemicals, and so on. The best quality production can be achieved using innovative solutions but also by looking far into the future when making production decisions.

This year's presentations will focus on a variety of topics, ranging from the importance of innovations in agriculture and the possibilities for sustainable intensification, all the way to resilience to disease epidemics in animal husbandry and biodiversity dynamics in agriculture. For the first time we will also publish the conference proceedings, to help further spread the ideas discussed at the forum.

I hope the conference will encourage you to think further about the important role agriculture plays in our world, not just as a means of producing healthy food, but also as a biodiversity caretaker and driving force in the development of rural areas.

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Agroforum Mare Balticum 2016

INTRODUCTION

Towards Environmentally Smart Agriculture (ESA)

It is crucial to determine the balance between intensification and environmental sustainability in contemporary agriculture.

Efficient use of resources forms a basis for smart and precision agriculture, which is one of the cornerstones of environmentally smart agriculture (ESA).

Agriculture is vulnerable to the impacts of environmental change. Farmers face both production and price risks.

The aim of ESA is to increase yield per unit of land to meet today's needs without exceeding current resources or reducing the resources needed for the future and achieve sustainable intensification via smart agricultural practices.

Current situation in European agriculture has to meet new challenges due to volatile agricultural markets and uncertain political situation in neighbouring countries. Past events have shown various bottlenecks in contemporary food production and trade. In order to provide for global food security, it is necessary to intensify agriculture, boost production, and increase competitiveness in Europe and in the Baltic Sea Region. On the other hand we have a need for more efficient use of resources, reduced resource usage intensity, decrease biodiversity loss and overall environmental degradation.

It is crucial to determine the balance between intensification and environmental sustainability in contemporary agriculture. Mitigation of, and adaptation to climate change, together with aiming for "green growth" are at the top of the agricultural development agenda. Limited resources, population growth and environmental concerns all challenge agricultural productivity. Developing resilient agriculture will require technologies and practices that build on agro-ecological knowledge and enable small-scale farmers to counter fluctuating market prices, environmental degradation and climate change in ways that maintain sustainable agricultural growth. Co-operative SME partnerships can also build the resilience of people by building diverse living and livelihoods.

Europe 2020 strategy aims for smart and sustainable growth and lays a great emphasis on innovation as this provides real benefits for citizens, consumers, and workers. **Efficient use of resources forms a basis for smart and precision agriculture, which is one of the cornerstones of environmentally smart agriculture (ESA).**

As defined by the FAO, 'climate-smart agriculture' „sustainably increases productivity, resilience (adaptation), reduces greenhouse gases (mitigation) while enhancing the achievement of national food security and development goals". FAO's Strategic Objective 4 focuses on enabling inclusive and efficient agricultural and food systems. Increasing the participation of smallholder producers as well as economically small countries in local, national and global food and agricultural markets is critical to achieving FAO's goal. Improving the efficiency of such systems helps to ensure the responsible use of available natural resources, improve incomes, reduce food losses and waste, and facilitate the delivery of products that are healthy and safe to eat.

FAO's Strategic objective 2 sets the goal to increase and improve provision of goods and services from agriculture, forestry and fisheries in a sustainable manner. Meeting environmental challenges, moving towards a greener economy, ensuring distributional equity, economic resilience and sustainability of production systems are the foundation for SO_2.

Economic transition and the transformation of agricultural markets in post-Soviet countries has coincided with the process of globalization and deepening trade integration both within the region and worldwide. The CIS (Commonwealth of Independent States) region plays an increasingly important role as a supplier and consumer of agricultural commodities to and from international markets. These developments also have implications for the Nordic and Baltic countries, considering their substantial economic and commercial ties with the CIS countries and their shared environmental challenges.

This unique role of agriculture presents a range of technical, environmental, social, and economic challenges, and all relevant stakeholders – farmers and food producers, policy makers, civil society, and scientists among them – grapple with ensuring food security in a climate-constrained world. In order to guarantee food security for everybody it is necessary to develop agriculture and the food system in such a way that they:

- are more resilient to the impacts of environmental change and other shocks and crises;
- contribute less to the global climate change and reduce the impact of agricultural pollution on the Baltic Sea;
- ensure that the contemporary food production systems provide food with high nutritional value, thereby maintaining and increasing public health.

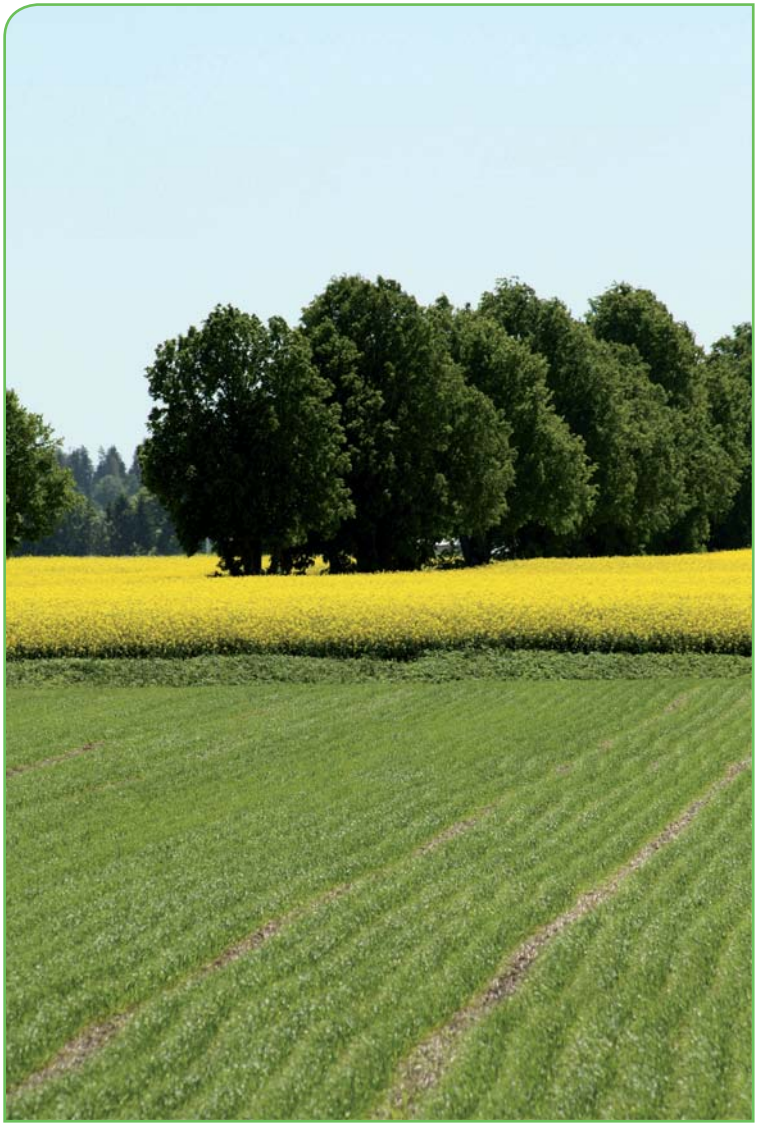
Agriculture is vulnerable to the impacts of environmental change. Farmers face both production and price risks. That is why it is important for the small- and medium size food producers to increase their technological and professional know-how to develop and adopt farming practices that make them more resilient to such changes. Crop rotation, more efficient use and cycling of soil nutrients, conservation farming, micro-dosing of fertilisers and herbicides, integrated pest management, disease- or stress-resistant varieties, the formation of co-operations of SMEs, and the diversification of production and markets can reduce the risks. Another promising way to reduce risks is through the use of improved small-scale machinery that smallholder farmers and co-operations can afford. More sustainable agricultural practices would take into account and estimate the resilience of the land and monitor and balance the input and output of organic matter.

The aim of ESA is to increase yield per unit of land to meet today's needs without exceeding current resources or reducing the resources needed for the future and achieve sustainable intensification via smart agricultural practices. Resilience in ESA provokes transformative changes in meeting the demands of food security, natural resource protection, and development. It diminishes vulnerability and promotes adaptive capacity by timely action and through the application of best practices to reduce such risks as variable weather, price and market volatility, misjudgements in farm management, etc.

To discuss the issues above the Estonian University of Life Sciences

(EMU) together with the Estonian Ministry of Rural Affairs has convened an international forum to bring together all stakeholders involved in agricultural development – policy makers, entrepreneurs and scientists – from all the Baltic Sea countries as well as from Eastern Partnership countries. Bringing together stakeholders from all levels enables them to learn from each other and focus on the most pressing issues in agriculture and related fields. Herewith it is a good platform for developing trade relations as well as transferring know-how between the East and the West.

This is the fourth time we are organising the international forum **Agroforum Mare Balticum** at the EMU in Tartu. The forum is in this format quite unique. Today there is a pressing need for wider communication to discuss urgent matters, be it agricultural potential of the European region, fair trade with minimal restrictions or sustainability of food and agriculture. Our topics have been driven from the fact that agriculture and food production are using a substantial share of natural resources: 70% of water and 40% of energy. To meet the demands of the growing population food production has to increase by at least 50% by 2050. These global issues are also important to the Baltic Sea region and its neighbours in the East. Agroforum Mare Balticum provides an opportunity for group discussions in roundtables and intergroup communication in plenaries, and a transmission from sector specific high reliability organisations to wider public in understandable language.



TOWARDS ENVIRONMENTALLY SMART AGRICULTURE

The present collection of abstracts has been published within the framework of the CBSS project "Environmentally Smart Agriculture", which focuses on some of the means to determine the balance between intensification and environmental sustainability in contemporary agriculture. Limited resources, population growth and environmental concerns all challenge agricultural productivity. Resilience in agriculture calls for the introduction of such technologies and practices that build on agro-ecological knowledge and enable farmers to counter fluctuating market prices, environmental degradation and climate change in ways that maintain sustainable agricultural growth, as well as build diverse living and livelihoods for the rural population. Taking into consideration their long-term economic and commercial ties and their shared environmental challenges, these developments affect the Baltic Sea countries equally.

This booklet contains three country studies that describe the current agriculture-related situation in Estonia, Poland and the north-western region of the Russian Federation and determine the bottlenecks that the countries face. For the data to be easily comparable an institutional framework was agreed upon and a list of indicators was worked out. The three articles give an overview of the goals and policies introduced, as well as of the changes in agriculture over a twelve-year period. The fact that the statistics collected are compared to information from the Leningrad region makes the data collected and described even more intriguing.

The input from the present project will form the starting point for future activities, which will include a project application within the Interreg Baltic Sea Region programme. The thematic session - Innovation and Environmentally Smart Agriculture - offers a deeper insight into the country comparisons.

TOWARDS ENVIRONMENTALLY SMART AGRICULTURE – CASE STUDY OF ESTONIA

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Introduction

This paper reviews developments towards environmentally smart agriculture in Estonia, with a focus on changes in agricultural and environmental policies, and associated changes in agricultural production and environmental indicators.

The first section presents some basic facts about the natural conditions for agricultural production, and the position of agriculture in the national economy during the period from 2004-2014. The second section reviews the main changes in the policy framework – the major institutional changes in Estonian society and economy since 1991, and changes in agricultural, rural development and environmental policies since the accession of Estonia to the European Union (EU) in 2004. The third section reviews the major changes in Estonian agriculture and associated environmental indicators with a focus on changes at the beginning of transition, and after EU accession. In addition to summarising the main agricultural policies, production and environmental developments, the concluding section outlines the environmental challenges that Estonian agriculture faces in the mid-term.

Agricultural land use, holdings, employment, trade, and position of agriculture in the national economy

In 2015, the population of Estonia was ca 1.31 million and the population density was ca. 30 inhabitants per km² (based on the mainland area of Estonia), which makes Estonia one of the least inhabited

countries in Europe. The total area of Estonia is 45,339 km^2, almost half of which is covered by forests. In 2014, the utilised agricultural area (UAA) comprised 22% of the total area of Estonia. From 2004-2014, the UAA increased by 23%, to 974,800 ha. In the same period, the area of arable land increased by 25% to 648,100 ha. The area of agricultural land not used for agricultural production but maintained in good agricultural and environmental condition increased by 458% to 122,400 ha. The area of orchards decreased in this period by 58% to 6,200 ha, and the area of permanent grassland decreased by 16% to 197,600 ha. Agricultural land under certified organic crop management increased during 2004-2014 by 238%, to 155,600 ha. In 2014, UAA per inhabitant was 0.74 ha (which in 2004 was 0.58 ha). Arable land per inhabitant increased from 0.38 ha in 2004 to 0.49 ha in 2014. The increase in agricultural and arable land *per capita* implies that agricultural production *per capita* has increased, which, to some extent, positively affects the general economic development. (Eurostat; EEA, 2016; MoE, 2013; SE, 2016)

While the UAA has increased, the number of agricultural holdings decreased by 49%, to 18,755, from 2003-2013. In 2013, agricultural holdings of ≤50 ha comprised 84% of all agricultural holdings. These holdings used 18% of agricultural land. Compared to 2003, the number of agricultural holdings in this size class decreased by 54% by 2013, and their agricultural land use decreased by 37%. The number of agricultural holdings in the size class 50-<100 ha was 1,152 in 2013 (6% of all agricultural holdings). Their land use comprised 8% of the UAA. From 2003-2013, the number of holdings in this size class increased by 10% and their UAA increased by 12%. From 2003-2013, the number of agricultural holdings of ≥100 ha increased by 65% to 1,794. Their UAA increased by 56% and comprised 74% of the total UAA (SE, 2016). Therefore, in the period 2003-2013, agricultural production has become concentrated into larger agricultural households.

In the period from 2004-2014, the number of persons employed in agriculture decreased by 33% to 16, 200. While in 2004, 4% of the working age population (1.8% of the total population) was employed in agriculture (crop and animal production, hunting and related service activities), by 2014 these figures had declined to 2.6% and 1.2%, respectively (Figure 1). From 2004-2014, the GDP *per capita* increased more than two times. Over the same period, the contribution of agriculture, forestry and fishing to the GDP decreased by 0.5 percentage points to 3.4% (in 2014), the trend and level similar in many developed countries. The contribution of crop and animal production, hunting and related service activities to the GDP was 1.9% (SE, 2016; WBG, 2016).

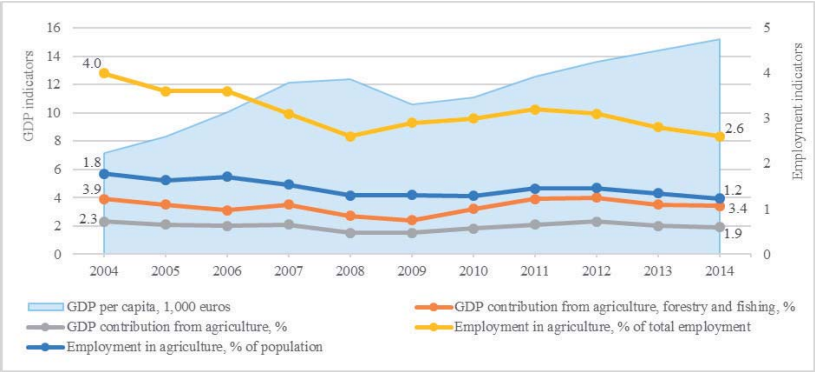

Figure 1. GDP and employment indicators in Estonia 2004-2014. *Source: SE, 2016.*

The share of agricultural produce and food in Estonia's total exports and imports was respectively 10.1% and 10.7% in 2014 (Figure 2). While from 2004-2014, the balance of trade of agricultural produce and food was negative, the negative position was reduced by 1.1 percentage points from 2004-2014.

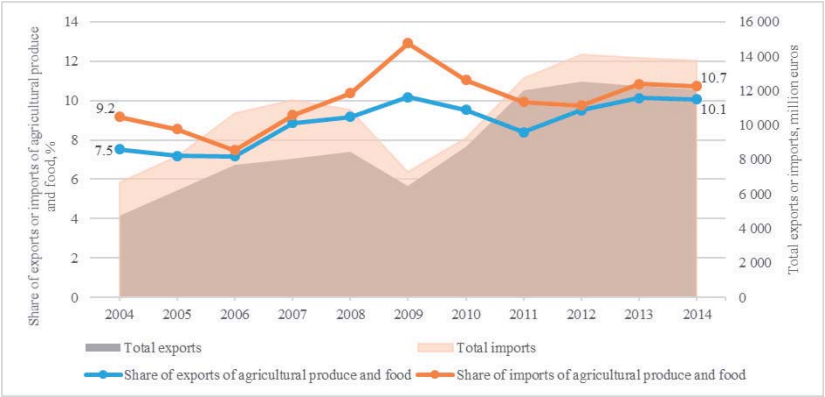

Figure 2. Share of exports and imports of agricultural produce and food in Estonia 2004-2014. *Source: SE, 2016.*

Considering the *per capita* agricultural land resource, Estonia has potential to make its contribution to the world food problem – increase agricultural production by 60% by 2050 in order to satisfy increasing world food demand. (OECD, 2012; OECD/FAO, 2012)

POLICY FRAMEWORK

Institutional changes

During the last 25 years, there have been significant social, institutional and structural changes in Estonia. In this period, the two events with the most comprehensive effects (also on agriculture) were the restoration of the independence of the Republic of Estonia in 1991, and membership of the EU in 2004. After restoring independence, Estonia transformed from a state-driven command economy to a liberal market economy and reoriented from Eastern (previous Soviet) markets to Western markets. In 1995, several agreements were signed with the European Union (EU): a free trade agreement, a European agreement, and Estonia submitted its application to become an EU member state. This induced harmonisation of many regulatory frameworks and legal norms with the EU's *acquis communautaire* (Viira et al., 2009; Viira, 2011; EI, 2016; SE, 2016).

Adaptation to the new conditions posed a challenge for Estonian enterprises. The previous economic system had collapsed but the new institutions were not yet established, and had to be built. In these circumstances, production declined in all economic sectors, causing a decrease in GDP of 36% from 1990-1994. In 1995, economic growth recovered because of economic restructuring and a low GDP base. The contribution of retail trade, transport and logistics and services to the GDP increased, while the contribution of processing industries and agriculture to the GDP declined (in the period from 1989-1999, from 35.1% to 13.7% and 22.0% to 3.3%, respectively).

For agriculture, the transition was difficult. As a result of ownership, agricultural and land reforms, kolkhozes (collective farms) and sovkhozes (state farms) disappeared. Many of them were privatized; however, parts of their agricultural land were restituted to previous

owners or their heirs. Based on the restituted farmsteads, agricultural land, and privatised agricultural land, and collective and state farms, new farms and agricultural enterprises were established. The new farms and agricultural enterprises had to compete with cheap (subsidised) imported agricultural and food products mainly from the EU countries. At the same time, agricultural producers needed new equipment and machinery, but due to unfavourable terms of trade (from 1992-1994 the producer support estimate (PSE) was negative), they lacked the means to make the necessary investments. Until 1998, the government did not provide significant support measures for the agriculture and food industries. Until the year 2000, no significant trade restrictions or barriers were used to protect producers against the negative effects of subsidised imports. At the end of the 1990s, export of agricultural and food products to Russia (which had been one of the main export markets) declined markedly due to the economic crisis in Russia and double import tariffs established by the Russian Federation. Therefore, from the 1990s and until EU accession in 2004, the Estonian agricultural and food sector operated in a harsher competitive environment compared to its main trade partners (EU and other post-communist countries). (Viira, 2014)

Changes in agricultural policy after EU accession

The Common Agricultural Policy (CAP) is one of the central EU policies. Over the years, the general aims of the CAP have remained intact. The aims still include sufficient availability of safe and high quality food, stabilising prices, improving the competitiveness of agricultural households, rural development etc. As a result of the CAP reforms over the previous 25 years, in part, the CAP has been modernised. In addition to improving competitiveness and productivity of agricultural households, farm sustainability and resilience-related goals have gained importance (greener farming practices, applied research and dissemination of knowledge, a fairer support system for

farmers, and a stronger position for farmers in the food chain). (EU, 2015; EU, 2016; MoRA, 2016b)

Direct payments

One of the main aims of the CAP's direct payments is to support farm incomes. Indirectly, direct payments also contribute to increasing the competitiveness and resilience of farms. One of the main changes in the CAP after the 2003 Fischler reform was the decoupling of direct payments from the obligation to produce certain agricultural products. After the EU accession, Estonia applied direct payments under the Single Area Payment Scheme (SAPS) that allowed for paying complementary (top-up) payments from national budget (EMÜ, 2008; Volmer, 2012; Aamisepp and Matveev, 2012). From 2004-2014, 1,027.6 million euros of direct payments were paid (Table 1). Single area payments comprised 67% of the direct payments. A single area payment was conditional on maintaining the land in good agricultural and environmental conditions. Therefore, this payment was one of the main factors in the increase in of agricultural land not used for agricultural production but maintained in good agricultural and environmental condition. While from 2004-2006 the direct payments coupled to production comprised 50% of the total amount of direct payments, their share started to decline from 2007. From 2010-2014, coupled direct payments comprised 1.4% of the total amount of direct payments.

Since 2015, direct payments have had a new internal structure. In addition to the single area payment (basic payment), greening, and the young farmers' scheme are available in Estonia. Voluntary coupled support is paid for dairy cows, suckler cows and heifers of up to 8 months of age, for ewes and nanny goats and for fruits and vegetables. In the period 2014-2020, one of the aims is to target direct payments in a way that they benefit inactive farmers less and active farmers

Table 1. Paid direct payments in Estonia, 2004-2014, in million euros

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Single area payment	21.1	27.8	30.7	44.5	50.6	60.6	70.5	80.5	90.6	99.8	108.1
Payment for energy crops	-	-	-	-	0.4	0.8	1.0	-	-	-	-
Special payment for the milk sector	-	-	-	-	-	-	1.2	1.2	1.2	1.2	1.3
Special payment for pig farms	-	-	-	-	-	-	-	-	-	-	2.7
Payments coupled to production	25.2	22.3	31.3	18.4	10.7	14.4	2.6	2.5	2.6	2.8	0.0
Complementary direct payment for field crop production	*13.1*	*10.2*	*16.1*	*16.6*	*8.3*	*12.8*	*0.4*	-	-	-	-
Complementary direct payment for suckler cows	-	*0.5*	*0.9*	*1.3*	*1.8*	*1.1*	*1.7*	*2.0*	*2.0*	*2.1**	-
Complementary direct payment for ewes	*0.3*	*0.4*	*0.4*	*0.5*	*0.6*	*0.4*	*0.5*	*0.6*	*0.6*	*0.7*	-
Complementary direct payment for dairy cows	*6.9*	-	*10.1*	-	-	-	-	-	-	-	-
Complementary direct payment for cattle	*4.9*	*11.2*	*3.8*	-	-	-	-	-	-	-	-
Decoupled direct payments	-	-	-	22.1	39.2	14.3	32.0	33.3	29.9	27.9	0.1
Complementary direct payment for agricultural crops	-	-	-	-	*14.0*	*0.0*	*15.3*	*14.8*	*14.3*	*9.3**	*0.0*
Complementary direct payment on the basis of milk production quota	-	-	-	*16.1*	*17.7*	*9.6*	-	-	-	-	-
Complementary direct payment for milk	-	-	-	-	-	-	*10.8*	*12.3*	*13.8*	*13.1**	*0.0**
Complementary direct payment payable for livestock units of cattle	-	-	-	*6.0*	*7.3*	*4.5*	-	-	-	-	-
Complementary direct payment for cattle	-	-	-	-	-	-	*5.7*	*6.0*	*1.8*	*5.4**	*0.0**
Complementary direct payments for ewes	-	-	-	-	*0.1*	*0.1*	*0.2*	*0.2*	*0.1*	*0.1**	-
Complementary direct payment for hay seed	-	-	-	-	*0.1*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0**	-
Total	46.3	50.1	62.0	85.0	100.9	90.1	107.3	117.6	124.4	131.7	112.1

*transitional measure. *Source: Aamisepp and Matveev, 2012; ARIB, 2016a.*

more. More attention is also paid to environmental externalities in agriculture. The aims are to maintain soil quality, permanent pastures, and biodiversity. Obligatory greening comprises 30% of the budget of the direct payments (MoRA, 2014). In Table 2, the unit payment rates of direct payments for 2015 are presented.

Table 2. Direct payments in Estonia in 2015

	Conditions	Unit	Unit payment rate, euros	Paid direct payments, million euros
Single area payment (basic payment)	-	ha	79.51	69.6
Greening	-	ha	36.14	31.4
Young farmers' scheme	For up to 39 hectares	ha	19.87	0.3
Payment for dairy cows	Paid to holdings with less than 100 dairy cows	Livestock units	130.8	1.7
Payment for suckler cows	For herds that have ≤25 suckler cows and heifers of up to 8 months of age	Livestock units	91.32	0.8
Payments for fruits and vegetables	For growing fruits and vegetables on at least 1 ha of land	ha	572.86	0.7
Payment for ewes and nanny goats	For ewes and sheep in herds with 10-100 ewes or nanny goats that are at least one year old	Livestock units	15.88	0.3
Small farmers' scheme	-	-	-	1.3
Total	-	-	-	106.2

Source: ARIB, 2016a; ARIB, 2016b.

From 2014–2020, the national ceiling for direct payments is 897.2 million euros. Of this amount, 97.3 million euros (11%) is transferred to the II pillar of the CAP (rural development measures) (MoRA, 2014).

Rural Development Programmes

The general aim of the Estonian Rural Development Programmes (ERDP) is to support territorially balanced development of rural areas. The main aims of the ERDP 2004-2006 were to assist the agricultural sector to become more environmentally friendly, and to improve the sustainability of agricultural producers situated in less favoured areas. In the same period, the third priority of the National Development Plan (ENDP) was targeted to supporting agriculture, fishing and rural development. Investment support measures for agricultural producers comprised the largest part of the third priority. ERDP 2007-2013 was targeted towards increasing the competitiveness of agriculture and forestry, improving the environment and the quality of rural life, and diversification of the rural economy. ERDP 2014-2020 aims to support rural development in coherence with pillar I of the CAP, the EU cohesion policy and the EU common fisheries policy. (MoA, 2008; MoA, 2011; MoA, 2013; MoRA, 2016c)

From 2004-2006, the main priority was support for agricultural investments, the agri-environment, and meeting EU standards (Table 3). From 2007-2013, in addition to supporting investments in agricultural holdings and supporting environmentally friendly production practices, more focus was put on the diversification of economic activities in rural areas (including the LEADER approach – local empowerment through local strategy development and resource allocation) and supporting the development of organic farming. As mentioned in the first section, agricultural land under certified organic crop management increased from 2004-2014 by 238% to 155.6 thousand hectares. In the period of 2014-2020, the largest share of the ERDP budget is targeted at investments into agricultural holdings and the processing industry. The budget allocated to support diversification of economic activities in rural areas will decline by 25%. But budget allocations to support the use of environmentally friendly production practices

will increase by 73%, and budget supporting for organic farming will increase by 39%.

Table 3. ENDP 2004-2006 and ERDP 2004-2006, 2007-2013, 2014-2020 measures and budgets in Estonia, million euros

	2004-2006	**2007-2013**	**2014-2020**
ENDP Measure 3.1 Investment into agricultural holdings	39.4	-	-
ENDP Measure 3.2 Investment support to improve processing and marketing of agricultural products	11.3	-	-
ENDP Measure 3.3 Diversification of economic activities in rural areas	7.4	-	-
ENDP Measure 3.4 Integrated land improvement	8.6	-	-
ENDP Measure 3.5 Renovation and development of villages	6.3	-	-
ENDP Measure 3.6 Local initiative based development projects – LEADER	1.8	-	-
ENDP Measure 3.7 Forestry	2.6	-	-
ENDP Measure 3.8 Support for setting-up and provision of farm advisory and extension services	1.3	-	-
ENDP total	78.8	-	-
Support for less-favoured areas	70.9	-	-
Agri-environmental support	27.5	-	-
Support for afforestation of agricultural land	9.8	-	-
Support for semi-subsistence farms undergoing restructuring	11.1	-	-
Support for meeting standards	35.0	-	-
Support for the areas with environmental restrictions (Natura 2000 areas)	1.2	-	-
Complements to direct payments	27.1	-	-
Technical assistance	3.1	-	-
SAPARD	2.4	-	-
Knowledge transfer and information actions	-	3.9	12.0

Advisory services, farm management and farm relief services	-	5.1	8.6
Quality schemes for agricultural products and foodstuffs	-	0.0	1.0
Investments for improving the competitiveness of agricultural holdings	-	191.1	146.0
Investments for processing and marketing of agricultural products	-	45.0	67.0
Development and maintenance of agricultural and forest land infrastructure	-	47.6	49.0
Restoration of stone walls	-	4.0	2.5
Support for starting business as young farmers	-	24.5	22.1
Development of small agricultural holdings	-	0.0	30.0
Diversification of economic activities in rural areas	-	76.4	57.0
Improving economic and ecological viability of forests	-	14.2	10.0
Setting-up of producer groups and organisations	-	4.5	6.0
Natura 2000 support for agricultural land	-	5.0	4.7
Natura 2000 support to private forestland	-	20.1	28.0
Environmentally friendly management	-	105.2	181.8
Support for endangered animal species	-	3.5	7.5
Support for growing local plant varieties	-	0.9	0.6
Support for maintenance of semi-natural habitats	-	26.8	40.2
Regional water protection support	-	0.0	5.0
Regional soil protection support	-	0.0	6.0
Support for environmentally friendly horticulture	-	0.0	3.9
Organic farming	-	55.8	77.7
Animal Welfare	-	25.3	40.6
Co-operation	-	5.4	18.7
Support for LEADER local development (CLLD – community-led local development)	-	85.8	90.0
Technical assistance	-	0.0	38.9
Financial instrument	-	0.0	38.0
ERDP total	188.2	749.9	992.8

Source: MoA, 2005; MoA, 2008; MoA, 2013

Environmental Policies

One of the main priorities of the Estonian RDP 2014-2020 is environmental protection, regarding water, soil, and biodiversity. Of the ERDP budget, 37% has been allocated for these aims. It is expected that around 70% of farmland will be under agri-environmental commitments (i.e. ERDP agri-environmental contracts involve ca. 70% of farmland). As drainage systems have been installed on more than half of the agricultural land (without drainage, the soil would be waterlogged), it is necessary to keep the drainage systems in good condition. Because of its various landscapes and diverse habitats, Estonia has many areas of high nature value. Pan-European ecological network Natura 2000 areas cover 16.5% of the country and a total of 55,000 ha of farmland. Eutrophication has not been a problem because of the relatively low proportion of intensively managed agricultural land, except in Central Estonia where farming is more intensive. By the regulation of the Government of Estonia, Central Estonia has been designated as a Nitrate Vulnerable Area[1] in 2003. In general, the state of the agri-environment in Estonia is good, but intensification and concentration of farming increase the risk of such negative externalities as nutrient leaching, pollution, loss of biodiversity and the spread of animal and plant diseases. (EC, 2016; MoE(a))

A number of activities will be undertaken in the ERDP framework to avoid deterioration of the agri-environment (the list of environmental measures in the ERDP has doubled). In 2014-2020, for the first time, the ERDP agri-environmental measures include a water protection measure for the Nitrate Vulnerable Area, a soil protection measure, support for a larger number of local plant crops, support for environmentally-friendly horticulture and activities related to main-

[1] Nitrate Vulnerable Area is an area where agricultural activity has caused or can cause nitrogen content of >50 mg/l in groundwater, or which surface water bodies are eutrophicated or in danger of eutrophication because of agricultural activity. *(MoE(b))*

taining habitats for farmland birds and bumble-bees. Support for the maintenance of semi-natural habitats will cover 2.6% of farmland. Support is foreseen for organic farming, which will cover around 14% of farmland. (EC, 2016)

In addition to agri-environmental policy measures that are the responsibility of the Ministry of Rural Affairs, general environmental policy is the responsibility of the Ministry of Environment, which is responsible for national environmental and nature protection, fulfilling tasks related to land and databases containing spatial data, organising the use, protection, reproduction and accounting for natural resources, ensuring radiation protection (from excessive radiation from artificial and natural radiation sources), tasks related to reducing the 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 effective agri-environmental policy assumes a good coordination and co-operation between the two ministries.

Changes in the agricultural sector

The disappearance of the planned economy and previous markets, unfavourable market conditions, immature institutions and a very liberal agricultural policy induced a decline in agricultural production in the 1990s. Together with the decline in agricultural production, the environmental effects arising from agricultural production were reduced. The number of agricultural animals decreased, and as a result, manure production and application on fields declined. From 1992-1997, the application rate of organic fertilizers per fertilized hectare decreased by 53% from 59 to 28 tonnes (Figure 3). The agricultural area fertilized with organic fertilizers decreased by 26% from 122 to 90 thousand

hectares. Due to unfavourable trade terms, agricultural producers lacked finances for the purchasing of inputs such as mineral fertilizers and crop protection material. From 1992-1997, the agricultural area that was fertilized with mineral fertilizers decreased by 60% from 830,000 to 333,000 ha, and the average quantity of mineral fertilizers applied to fertilized agricultural land declined by 58% from 204 to 86 kg per hectare. The decline in agricultural output and inputs was accompanied with positive environmental externalities, such as a decline in Estonia's agricultural greenhouse gas (GHG) emissions (CO_2 equivalent declined by 48% from 2,077 Gg in 1992, to 1,084 Gg in 2004. Then, from 2004 it increased, by 16% to 1,254 Gg in 2013), and reduced pollution of the Baltic Sea and other water bodies, due to reduced nutrient leaching (Tamm and Reiljan, 2005; Viira et al., 2009; Viira, 2011; Estonian NIR, 2015).

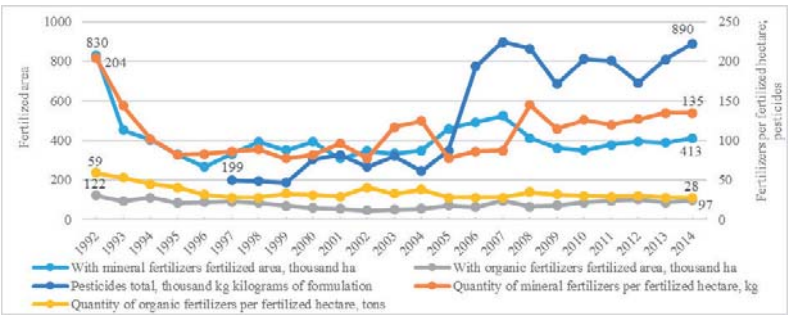

Figure 3. Use of fertilizers and pesticides in Estonia 1992-2014
Source: SE, 2016.

Since 2004, when Estonia became a member of the EU, many changes have occurred in Estonian agriculture. Today, the economic role of agriculture is considered in a wider context than previously. The segments of agriculture-related value chains (production and selling of inputs, transport and logistics, food and other processing industries,

wholesale and retail trade and catering) all contribute to the GDP. In addition, the social aspect of the development of rural areas, food security (food safety and availability of food, food self-sufficiency) as well as environmental and public health aspects are becoming more important.

Becoming a member of the EU had positive effects on Estonian agricultural production (Figure 4). From 2004-2005, the value of Estonian Agricultural output (adjusted with the agricultural output price index) increased by 45% from 483 to 698 million euros. Access to the markets of the EU countries improved. Also, trade barriers imposed by the Russian Federation were reduced. Therefore, the export of Estonian agricultural products to Russia increased after the EU accession. Adopting the common agricultural policy (CAP) of the EU enabled Estonian agricultural producers to receive direct payments (which were nevertheless significantly less than the EU average), agri-environmental payments, investment support. The food industry was able to benefit from common market regulation and investment support measures, and rural areas to benefit from rural development measures of the CAP (Tamm and Reiljan, 2005; Viira et al., 2009; Viira, 2011; EI, 2016).

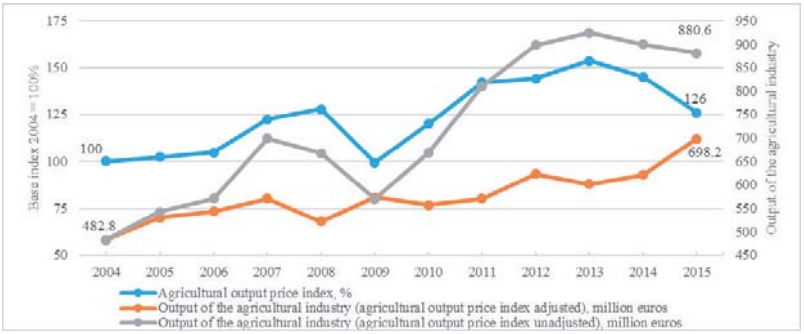

Figure 4. Agricultural output price index and output of the agricultural industry in Estonia 2004-2015. *Source: SE, 2016.*

From 2004-2014, (nominal) agricultural output has increased by 86% to 900.2 million euros (Figure 4). In 2014, crop output contributed 42.7%, animal output 47.1%, and agricultural services and non-agricultural activities of agricultural producers 10.2% to agricultural output. From 2004-2014, the share of crop output in total agricultural output increased by 8.0 percentage points, and the share of services and non-agricultural output increased by 0.5 percentage points. At the same time, the share of animal outputs in total agricultural output declined by 8.5 percentage points. The share of subsidies on products of the total agricultural output declined from 5.2% on 2004 to 0.4% in 2014 (Figure 5). This reflects the policy change common in many developed countries, where support coupled to agricultural production has declined. Other subsidies for production increased by 220% (from 52.5 million euros in 2004 to 168.2 million euros in 2014) (Figure 5), but since 2014, have begun to decline. Investment grants fluctuated during the period 2004-2014, depending on the implementation of the ERDP programme periods (increase in 2004 and 2008, decrease in 2014) and the economic cycle (decline in 2010) (SE, 2016). From Figure 5 it appears that after EU accession, the ratio of subsidies on products and other subsidies on production to the value of agricultural output (without subsidies on products) increased from 5.8% to 17.0%. By 2010, this ratio increased to 25.5%, and by 2014 declined to 19.2%. This indicates that the share of subsidies in the income of agricultural producers is decreasing.

From 2004-2014, the area under field crops increased by 23%, from 496 to 608 thousand hectares (Figure 6). The sown area of cereals increased by 28% to 333,000 ha. The area under industrial crops increased by 60% to 81,000 ha (SE, 2016). Compared to the beginning of the 1990s, the area under oilseed rape has increased significantly. The main contributing factors behind this growth are higher prices compared to cereals, and the building of a rapeseed-processing fac-

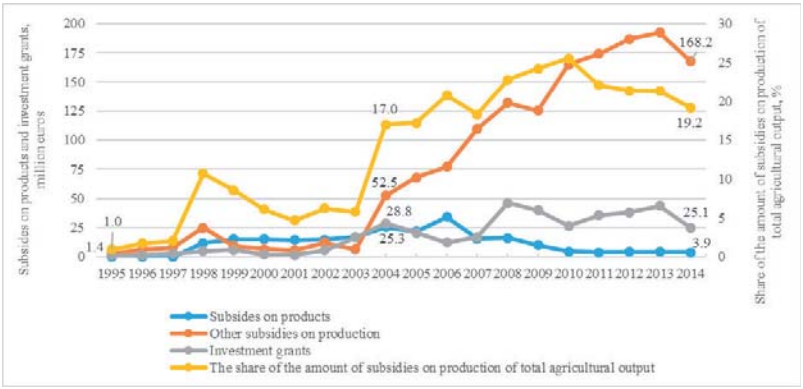

Figure 5. Subsides for products and investment grants in Estonia 1995-2014, million euros. *Source: SE, 2016.*

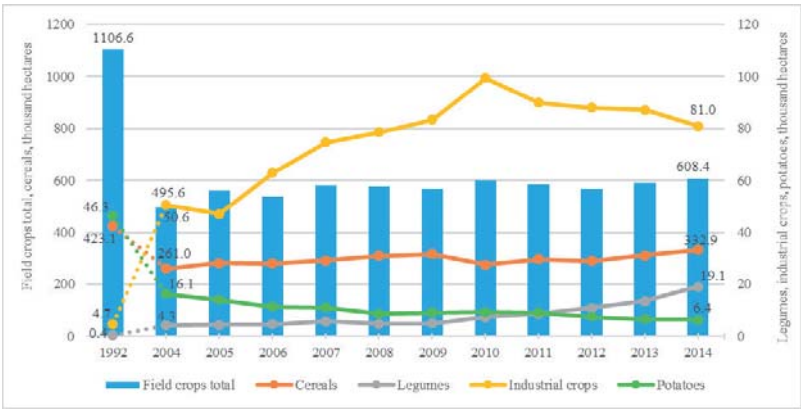

Figure 6. Sown area of field crops in Estonia in 1992 and 2004-2014, thousand hectares. *Source: SE, 2016.*

tory in the 1990s. Since 2009, the area of legumes has increased significantly, from 4,900 to 19,100 ha. This could partly be associated with the greening of the CAP, under which, growing nitrogen fixing crops has been one of the most popular practices. The sown area of

potatoes has decreased from 2004-2014, from 16,100 to 6,400 ha.

From 2004-2014, field crop yields have increased significantly (Figure 7). This could be associated with increased application rates of mineral fertilizers and pesticides, and adaptation of new technologies and agro-technical practices. The three-year moving average yield of cereals has increased from 2.3 tonnes per hectare in 2004 to 3.8 tonnes per hectare in 2014 (by 65%). During the same period, the average yield of potatoes has increased by 46% to 19.3 tonnes per hectare, the average yield of rape and turnip rape seed has increased from 1.5 to 2.2 tonnes per hectare (by 47%), and the average yield of legumes has increased by 127% to 2.5 tonnes per hectare.

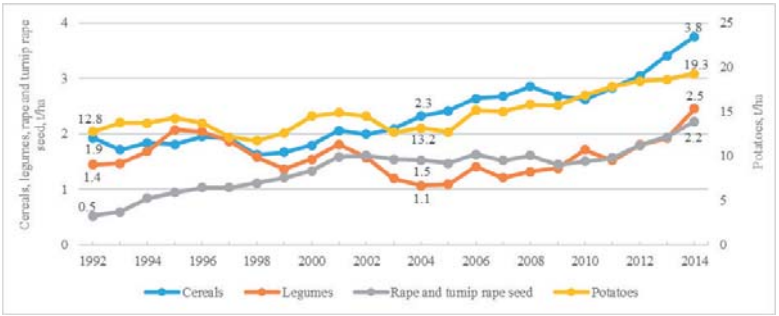

Figure 7. Three-year moving average yields of field crops in Estonia 1992-2014, tonnes per hectare. *Source: SE, 2016.*

From 2004-2014 the number of dairy cows decreased from 117,000-96,000 (Figure 8). At the same time, the numbers of other cattle increased, as beef farming has become more popular. Many smaller-scale milk producers have converted to beef production. However, average milk yield per cow increased by 49% to 8,233 kg/cow/year, and total milk production has also increased. The number of sheep and goats has more than doubled since EU accession and, until the outbreak of

African Swine Fever in the summer of 2015, the number of pigs was relatively stable (increased by 5% from 2004-2014).

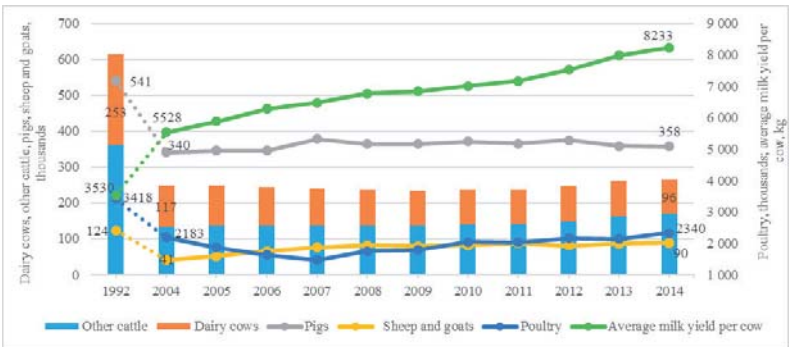

Figure 8. Livestock, poultry and productivity of dairy cows in Estonia in 1992 and 2004-2014. *Source: SE, 2016.*

Agricultural production in Estonia has become concentrated into larger holdings and become more intensive compared to the end of the 1990s. As a result, agricultural output has increased. However, some agri-environmental indicators have deteriorated in the period from 2004-2014. The farmland bird index has declined by 12 points (Figure 9), indicating reduced populations of bird species characteristic to Estonian agricultural landscapes.

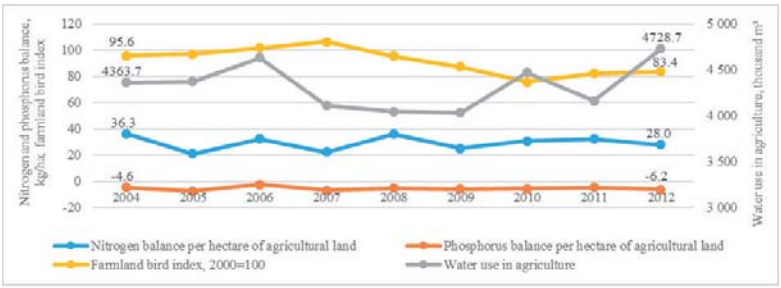

Figure 9. Agri-environmental indicators in Estonia 2004-2014. *Source: SE, 2016.*

Water use in agriculture depends on the weather (precipitation) but also on economic changes and changes in water use practices (EA). From 2004-2014 water use in Estonian agriculture was relatively stable, with a slight increasing trend (8% over the period). While agricultural water use is not a critical question in Estonian agriculture (agricultural water usage comprises 5% of total water use), the efficiency of water usage should be increased, and agricultural production causing outflow of nutrients (nitrogen, phosphorus) to inland water bodies and Baltic Sea should be avoided. (Värnik et al., 2012)

From 2004-2014, the nitrogen balance per hectare of agricultural land was positive, but the phosphorus balance per hectare of agricultural land was negative with a decreasing trend. From 2013-2015, cereal production increased from 1.0 to 1.5 million tonnes. In addition 0.2 million tonnes of rapeseed (which demand of nutrients, relative to its yield is larger than in case of cereals (EAaRAS)) was produced. Therefore, the amount of nutrients removed from soils increased by at least 50%. At the same time, mineral fertilizers use increased by 5-10% every year, and the number of agricultural animals (and quantity of manure production) has decreased. Therefore, the nutrient balances of soils have not improved and the production of cereals and rapeseed has occurred dependent on the nutrient reserves in soils. (Ameerikas, 2016)

Conclusions

Over the last 25 years, Estonian agriculture has gone through significant transformation. Agricultural commodity production is concentrated mainly in large agricultural holdings. From 2004-2014, agricultural production in Estonia has increased, as have exports of agricultural and food products. However, following the trend in many developed countries, the share of agricultural activities of GDP has declined. Yields of field crops and milk have significantly increased

since Estonia's EU accession in 2004. Yield growth in crop production is mainly the result of the adoption of new varieties and technologies, and increased use of mineral fertilizers and pesticides. The use of organic fertilizers has decreased due to the decrease in the number of agricultural animals. These have resulted in negative phosphorus balance, and decreasing aggregated nitrogen and phosphorus balance in the soil. In recent years, the farmland bird index, which is a biodiversity indicator, has declined, GHG emissions from agriculture have increased from 2004-2013, which indicates that the environmental impacts of agriculture and associated risks are increasing.

Estonian agriculture is facing several challenges, of which problems in export and domestic markets, and environmental (including climate related) challenges are currently the most relevant. Increasing Estonian agricultural production in order to satisfy increasing global food demand inevitably increases the risk of negative environmental externalities. CAP measures are contributing to reducing these risks via greening of direct payments and supporting environmentally friendly production practices, and investments into new technologies via rural development programmes. While in the 1990s the negative environmental impact arising from agriculture decreased, it is evident that increasing agricultural production in order to provide for economic growth and satisfy the growing world food demand will increase pressure on the environment. Therefore, in order to balance

the economic and environmental goals, Estonian agriculture needs to develop and adopt environmentally smart and economically efficient practices and technologies.

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TOWARDS ENVIRONMENTALLY SMART AGRICULTURE – CASE STUDY OF POLAND

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Introduction

Economic transition and European integration have contributed significantly to the restructuring of the agricultural sector in Central and Eastern Europe. Poland, like other countries which went through the transition and process of accession to the European Union, has faced many problems to be solved on the road to a free market economy. Political and economic developments have resulted in radical changes in the national economies of the Central and Eastern European (CEE) countries.

The agricultural sector was not an exception. In Poland, in the first years of transition which was initiated in 1989, farmers experienced severe financial difficulties mainly due to high inflation and the scrapping of the centralized price regulation system. Since the mid-1990s, however, preparations for accession to the EU, positive price trends and improved productivity resulting from increased inputs due to better terms of trade and technological advancements, had a positive impact on incomes from farming as well as on the modernization of Polish agriculture. New financial support measures, which re-established subsidizing of agricultural production after the almost complete removal of subsidies at the beginning of the transformation period, and the introduction of the CAP direct payments and other forms of support after EU accession, have injected additional funds into the farming sector available for investments. New economic policies, the recovery of the sector from the transition crisis as well as improved

profitability in agricultural production resulted in a growing demand for agricultural land and substantial changes in land ownership and farm structure.

The structural changes in Polish agriculture, which are the most vital result of transition to the market economy in the last 25 years, will be the main focus of this paper.

The Authors have also attempted to show some of the developments towards environmentally smart agriculture in Poland. Positive changes in this direction are discussed, although over such a relatively short period measurable effects of these changes are scarcely noticeable.

Agriculture in the national economy

Rural areas in Poland cover 93% of the country's territory. The total area of agricultural land is about 14.5 mln hectares, which places Poland in the 5th place in the European Union for agricultural land area. Polish agriculture absorbs a significant part of the work force of the country. In 1990, over 27% of the labour force worked in agriculture. In the mid-nineties the total share of those employed in the sector was reduced to 22%. Overemployment was, in the past, one of the characteristic features of the sector. In the 1990s, and in the first years of the 21st century, the outflow of employment from agriculture was restricted by the high rate of unemployment in the national economy. Due to economic growth in Poland, as well as the most recent structural and demographic changes, the share of those employed in agriculture in 2015 is estimated to be 13%[1] (table 1).

At the beginning of the transformation to the market economy in 1989, the share of the agricultural sector in GDP amounted to 8.4%.

[1] The whole European Union agriculture's share of employment from Eurostat data is 5.5% on average.

This share declined to 3.7% in 2004 and further to 3.5% in 2014. Despite this trend, which reflects development processes in the Polish economy and significant trends for growth in other branches of the Polish economy, agriculture is still an important sector due to its production and non-production functions.

Table 1. Characteristics of Polish agriculture

Specification	1990	2004	2014	2014 [2004=100]
Agricultural land [mln ha]	18.8	16.3	14.6	89.2
Number of farms [thous.]	2,139	1,854	1,395	75.2
Share of farms over 10 ha	17.4	20.1	23.8	118.4
Average farm size [ha]	7.1	7.5	9.5	126.7
Agricultural employment [% of total employment]	25.6	15.2	15	98.7
Share of agriculture of GDP (%)	13.8	3.7	3.4	91.9
Share of exports of agricultural produce (% of total exports)	5.4	8.8	13.1	148.9
Share of imports of agricultural produce (% of total imports)	1.9	6.2	9.2	148.4

Source: Main Statistical Office GUS – yearbooks

Agriculture is not only a source of food and raw materials for a range of different processing industries. It is also a vital partner for the industries that supply agriculture with the means of production. The agricultural sector also includes social functions resulting from its multi-functionality, and provides several public goods. In the case of Polish agriculture, it is very appropriate to say that, taking multi-functionality into account, the absorption of a significant part of the country's workforce, a strong contribution to Polish exports and improving food trade balance, the importance of the sector for the

national economy is much greater than its share in the Polish GDP could suggest.

Policy framework

Historically, agricultural policies in Poland have always supported the sector, although policy goals and measures have been different in specific periods.

In the long period of the centrally planned economy (1945-1989), regulated prices for agricultural commodities and supported prices for energy and other means of production for agriculture allowed farmers to achieve a relatively strong level of financial stability. Farm incomes were not high enough to allow for substantial investments and growth in the most effective farms. Agricultural policy in that period was in favour of the state and cooperative sector of agriculture. However, private, small scale family farmers were also beneficiaries of regulated prices and markets. In consequence, land ownership and farm size structures were frozen and developments in agriculture were limited. Although the productivity of the land slowly grew the supply of food was constantly lower than demand.

One of the first, key decisions in the initial phase of the transition to the market economy in the early 1990s was the freeing of all prices. In the past, as in all former socialist countries, prices were set "administratively, with little regard for cost and demand considerations" (Koen, De Masi 1997, p.5). Liberalization of prices resulted in high inflation, reaching in some cases a hyperinflation level, and a dramatic escalation of interest rates putting a number of farms (particularly for the many farmers with unpaid loans) into a critical financial situation. Adverse macroeconomic conditions and increased imports of agricultural and food products that competed successfully with domestic production led to a significant decrease in real agricultural incomes.

In the mid 1990's agricultural policy in Poland underwent further changes due to preparations for accession to the EU. Preferential credits, at interest rates subsidized by the state, which were significantly lower compared to commercial rates, were introduced in 1994. Until 2003 there were almost 300,000 loans for investments in the agricultural sector granted by banks on preferential terms (Rosa, 2011). Over time prices and interest rates have been "gradually converging across transition countries" and "prices of goods rapidly (have) moved toward international levels" (Koen, De Masi 1997). New support measures, including preferential interest rates, positive price trends and increased productivity resulting from technological advancements have had a strong impact on growing farm incomes. The recovery of the sector from a transition crisis, as well as the improving profitability of agricultural production, has resulted in a growing demand for agricultural land (Majewski, 2008), which was an important turning point, initiating future structural changes in the agricultural sector.

The implementation of the Common Agricultural Policy (CAP) after accession to the EU in 2004 has been a milestone for Polish agriculture. Easier access to EU markets, the introduction of direct payments, continuing positive price/cost relationship trends and subsidies from the Rural Development Program had a significant impact on the economic situation of the farming sector. The Rural Development Programme played a significant role in transforming agriculture in Poland. In the period 2007–2013 the Polish RDP focused on three key objectives: improving agricultural competitiveness, improving quality of life in rural areas and better protection of the natural environment.

Since 2007 funds from the Rural Development Programme have helped Poland to: modernise more than 37,000 agricultural holdings, generating investments of more than EUR 3.2 billion, to set up more than 23,000 young farmers, generating a total investment (public and

private) of more than EUR 452 million, to invest 1 billion EUR in services available to rural populations, and 345 million EUR in the renewal of ca 3,700 villages. The new rural development programme was implemented for the budgetary period 2014-2020. Total public funds allocated for the implementation of the RDP 2014-2020 amount to 13.5 billion Euros (EU and national funds).

For the new budgetary framework 2014-2020 the RDP priorities have been changed. Ensuring economic viability, modernization and enhancing competitiveness of the sector is still the main objective in Poland. The recently introduced RDP for the present budgetary perspective also focuses strongly on environmental aspects as well as on facilitation of knowledge and innovation transfer. The structures of RDP measures in Poland, Estonia and Sweden are presented in table 2.

Table 2. Structures of the Rural Development Plan for the years 2014-2020 in Poland, Sweden and Estonia

	Poland		**Estonia**		**Sweden**	
Item	**EUR**	**%**	**EUR**	**%**	**EUR**	**%**
Modernization, improving competitiveness	7,032	**52.0**	411.6	**41.5**	1,006.6	**23.4**
Natural environment related measures	4,351	**32.2**	405.9	**40.9**	2,567.2	**59.7**
Knowledge transfer, advisory work, farmers' cooperation	627.0	**4.6**	46.4	**4.7**	370.2	**8.6**
Other	1,503.3	**11.1**	128.9	**13.0**	356.3	**8.3**
TOTAL	13,513.3	**100.0**	992.8	**100.0**	4,300.3	**100.0**

Source: authors' calculations based on ARiMR and EU Commission Data.

In Poland the greatest part of the RDP funds goes for investments and programmes enhancing the introduction of technological advancements, modernization and, overall, improving the competitive position of Polish agriculture. Significantly more of the new RDP will be spent on activities supporting environmental protection and the delivery of public goods by the sector. For comparison, the structures of the Estonian and Swedish RDPs are presented. Differences are that the share of funds offered for the achievement of economic and environmental objectives are similar in the Estonian RDP, whilst in Poland modernization goals remain favoured. On the other hand, the main focus of the Swedish RDP is on supporting environmental goals.

Instability of agricultural markets and frequent emergency situations caused by, among others, anomalies in climate conditions, animal diseases, infections and product contamination result in the inclusion of crisis management elements into EU agricultural policy, allowing for quick actions to be taken with regard to producer support. Since accession to the EU in 2004 the agricultural sector in Poland has received financial support in consecutive years to mitigate the consequences of catastrophic events, such as severe droughts or extremely adverse market conditions for specific commodities (figure 1).

Structural changes in the agricultural sector

The structure of the agricultural sector can be defined in several ways, as discussed by Was (2013). From the macroeconomic point of view, it might be considered as a structure of basic production factors – land, labour and capital, which are used to produce agricultural output to meet demand, although in the production processes unwanted externalities are also generated. There is a specific relationship between volume and modernity of production factors and methods of production used, for countries and phases of development of agricultural sector, as well as production and economic results. Considering the allocation

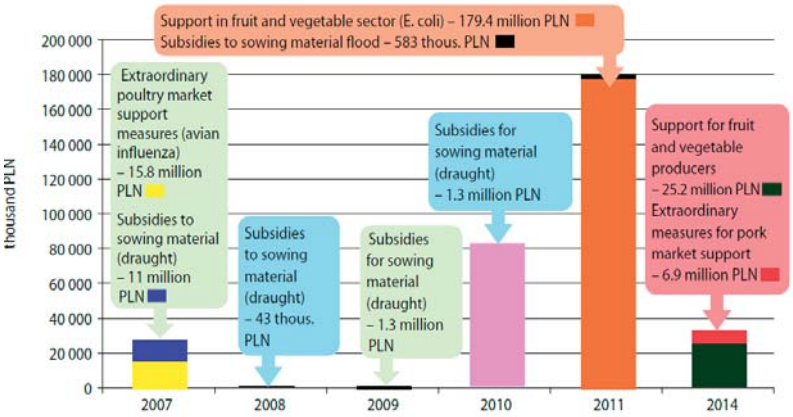

Figure 1. Support for agricultural producers in cases of catastrophic events and other extraordinary situations.
Source: MRiRW, 2015. Agriculture and Food Economy in Poland, p. 114.

of production, the structure of the sector can also be presented as a structure of farms, which in Poland is strongly diversified. Taking into account all these aspects the definition of the structure of agriculture proposed by Balmann (1997) is very appropriate: "who is producing what, in what amounts and by what means".

Developments in the agricultural sector in Poland after 1989, to a large extent policy driven (transition to the market economy, EU accession and introduction of the CAP, followed by financial support) resulted in significant changes in all dimensions of the agricultural structure.

For a number of decades before the transition agricultural land was divided in Poland between three sectors: family, state owned and cooperative farms, with a dominating share (about 75%) of private, individual farms in land use. As a result, the ownership structure of

agricultural land in Poland was unique among the former socialist Central and East European countries. Privatization processes, which were a part of the transformation to the market economy that has been initiated in Poland in 1989, led to a significant reduction of the state ownership of land (table 3).

Table 3. Changes in the structure of ownership of agricultural land in Poland (%)

Item	1990	2000	2010	2014
Private	**75.8**	**94.0**	**96.3**	**98.2**
Of which: Family Farms	71.9	86.8	88.1	90.0 (est.)
Public	**24.2**	**6.0**	**3.7**	**1.8**

Source: Authors' calculations based on GUS Statistical Yearbooks 1990-2015

Polish agriculture is characterized by a large number of farms and strong fragmentation of the farming sector but slowly, over time, the farm structure has improved – the number of farms has noticeably decreased and the concentration of agricultural land in a reduced number of farms is observed. According to national statistics there were 2,172,200 holdings in the year 2002, and 1,413,000 farms in the year 2014. This decrease was caused by a significant reduction in the number of the smallest farms, below 5 hectares of agricultural land (table 4).

Table 4. Structure of farms and structure of agricultural land use in Poland in the years 2002 and 2014

Item	Farm size cluster				
	0-5 ha	5-10 ha	10-20 ha	20-50 ha	Above 50 ha
Structure of farms [%]					
2002	58.7	21.8	16.9	1.6	1
2014	52	22.4	20.3	2.9	2.4
Change in % points	**-6.7**	**+0.6**	**+3.4**	**+1.3**	**+1.4**
Structure of agricultural land use [%]					
2002	16.7	18.4	31.5	7.2	26.2
2014	12.7	15	30.9	10.3	31.1
Change in % points	**-2.1**	**-1.9**	**-2.7**	**+1.4**	**+5.3**

Source: Authors' calculations based on Rolnictwo i Gospodarka Żywnościowa w Polsce. MRIRW, 2015.

At the other end of the spectrum, the number of larger farms is growing. Agricultural land is moving mainly to the cluster of the largest farms (50 hectares and more), while the change in the area of the smaller farms is negative. This trend is most likely to continue in the future leading to a concentration of the land in a decreasing number of farms.

It should be emphasized that the majority of the smallest farms (0-5 ha), as well as some farms from the 5-10 ha cluster can be characterized as subsistence or semi-subsistence farms. Their contribution to the market of agricultural produce is insignificant and non-agricultural sources provide the greatest part of the personal incomes of their owners.

One of the important and most characteristic changes in Polish agriculture is the concentration in the animal production sector (table 5).

Table 5. Concentration in livestock production in the period 1991 - 2013

	Share of the total national herd [%]			
	Pigs		Dairy cows	
herd size (units)	1-2	> 100	1-2	> 10
1991	12.4	**6.2**	40.6	**1.6**
2000	3.8	30.4	34.6	22.9
2005	2.5	44.5	22.2	50.2
2013	1.3	**63.4**	10.1	**72.9**

Source: Authors' calculations based on Main Statistical Office [GUS] yearbooks

In the past the majority of Polish farmers kept livestock in highly diversified, small farms. The smallest size herds have disappeared, and the livestock has moved to larger scale herds on specialized farms.

As a result of adjustments to the market situation and technological advancements in agricultural production, important changes have taken place in the national cropping structure (table 6).

Table 6. Changes in the cropping structure in Poland in the period 1990-2014 (%)

Crops	1990	1995	2000	2010	2014
Cereals	59.5	66.1	71	73.3	71.8
Potatoes	12.9	11.8	10.1	3.7	2.6
Sugar Beet	3.1	3	2.7	2.2	1.9
Rapeseed	3.5	4.7	3.5	9	9.1
Fodder crops	14.2	8.5	7.4	8.3	11.1
Other crops	6.8	5.9	5.3	3.4	3.5

Source: Authors' calculations based on Main Statistical Office [GUS] yearbooks

In 1990, at the beginning of the economic transformation, the share of cereals, dominating the cropping structure, was about 60%, followed by fodder crops (14.2%) and potatoes (12.9%). In the subsequent years cereals gained a greater share, up to a level of 72-73%, mainly at the expense of potatoes. Potatoes were traditionally used on small farms as the main component of feed for pigs. Along with the concentration of pigs in a smaller number of farms and larger herds, the feeding regime for pigs became more and more based on concentrates. This created an increased demand for cereals grown for feed, and has reduced the importance of potatoes. Also, the share of rapeseed was significantly increased, mainly due to the EU renewable energy policy imposing on fuel producers' requirement for the use of biofuel components.

Similar changes, technology and market driven, took place in the numbers of livestock (table 7).

Table 7. Livestock number in selected years (mln head)

Livestock group	1990	2004	2007	2014	2014 [2004 = 100]
Cattle	10.0	5.2	5.4	5.9	113%
of which: cows	*4.9*	*2.77*	*2.74*	*2.48*	*89%*
Horses	0.94	0.32	0.33	0.21	65%
Poultry	61.2	130.3	134.2	133.1	102%
Pigs	19.4	17.4	17.6	11.7	67%

Source: Authors' calculations based on Main Statistical Office [GUS] yearbooks

The most spectacular effect is the significant drop in the number of pigs. This is due to decreasing profitability of production, growing

competition within the EU market but also because of the withdrawal of small scale farmers from pig production. In other sectors of animal production, the situation has stabilized after accession.

Regarding fixed assets, which constitute the main component of capital in agriculture, again noticeable changes can be pointed out (table 8).

Table 8. Value of fixed assets in agriculture during the period 2005 - 2013

	2005	**2008**	**2011**	**2013**
Net value of fixed assets [mln EUR]	7,630.3	8,057.8	6,790.4	8,566.5
Cumulated depreciation [%]	71	74.9	76.8	76.7
Investments in fixed assets in agriculture:				
- total [mln EUR]	595.8	1,117.3	1,039.8	1,166.7
- per hectare	**37.46**	71.59	68.71	**79.86**

Source: Authors' calculations based on Main Statistical Office [GUS] yearbooks

A significant increase in investments in fixed assets in the years that followed accession to the EU should be emphasized. This reflects both the structure of the financial support for the farming sector, focused strongly on improving competitiveness of the sector, and the modernization needs. This is important because of the decapitalization of fixed assets in Polish agriculture on average. The investment processes increased the value of fixed assets in the agricultural sector, although the investments were concentrated in larger, economically viable clusters of farms. This deepened the polarization of the agricultural

sector in Poland, which in a highly simplified way can be seen as the co-existence of small, often semi-subsistence farms using traditional production technologies, and at the other end of the spectrum, large-scale, modern and competitive farm holdings.

Production and economic results

Productivity of the land and economic results are variable in Polish agriculture, depending strongly on the farm size and production orientation. The value of production per hectare of agricultural land in the sample of FADN farms differs significantly between the clusters of small, medium and large farms as presented in the figure 2.

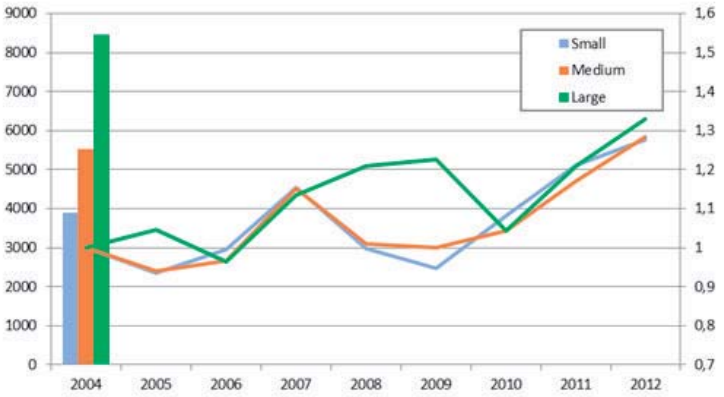

Figure 2. Productivity of land in Poland on farms of different sizes 2004-2012 [PLN/ha]. *Source: own calculations based on the FADN data*

What is noteworthy is that in the period after accession in 2004, the productivity of land grew at a similar rate in all three size clusters of farms. The initial value of production per hectare on the smallest size farms in 2004 was about 50% of productivity level on the largest farms.

The total agricultural output has grown over a long period of time in other countries – and in some of the new member states even at much higher rate than in Poland (figure 3).

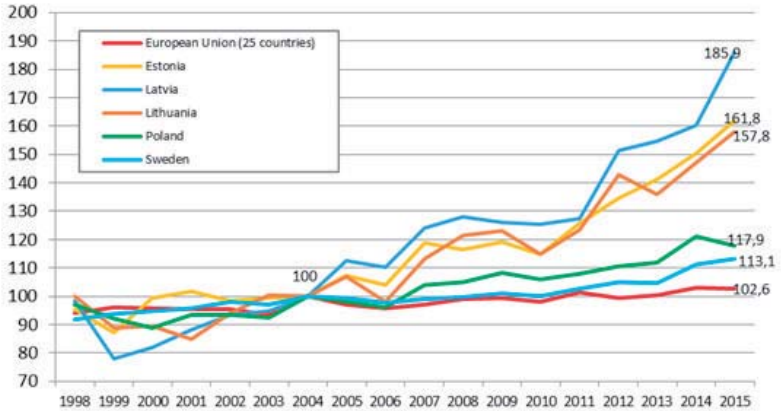

Figure 3. Dynamics of Total Agricultural Output change in Poland and in selected EU countries in the period 1998 – 2015 (2004=100).
Source: Authors' calculations based on Eurostat data

The increase in the agricultural output of some new EU Member States after accession shows the importance of financial support available consequent to the introduction of the Common Agricultural Policy and new market opportunities as a result of growth in domestic demand and increased exports. The total agricultural output of the European Union remained at about the same level in the period analysed despite a significant increase in output in several countries. The greatest and most impressive progress was achieved in the Baltic republics (Latvia, Estonia and Lithuania), but the indices for Poland were also significantly higher than the values for the overall EU25.

Analysis of the dynamics of total agricultural output in the period before accession shows that all transition countries experienced the shock of significantly falling production but recovered successfully after 2004.

Despite a significant increase in the productivity of labour in Poland and in other new member states, there remains a significant gap to the most advanced West European countries such as the Netherlands, Denmark, Germany or Sweden (table 9).

Table 9. Value of agricultural output per AWU (thousand euros/AWU)

Country	**1998**	**2004**	**2010**	**2015**
The Netherlands	101.6	123.4	145.5	157.8
Denmark	86.8	115.8	142.8	162.8
Germany	49.2	67.2	74.0	76.3
Sweden	43.1	51.9	61.2	75.1
Estonia	6.2	11.5	19.9	34.1
Latvia	3.3	3.9	8.0	13.3
Lithuania	4.7	7.7	10.3	13.4
Poland	4.8	6.2	7.9	8.7
Poland – FADN sample	n.a.	*10.7*	*15.6*	*18.3**
All EU	**24.7**	**31.2**	**35.9**	**39.0**

** Year 2013*

Source: Authors' calculations based on Eurostat data

In the case of Poland, although productivity of labour has slowly increased it has remained at a relatively low level in recent years, due to quite stable and high employment in the small-commercial and semi-subsistence farm sectors. Much higher values for the labour

productivity indicator characterizes farms from the FADN sample, which consisted of larger and more effective, market oriented farms.

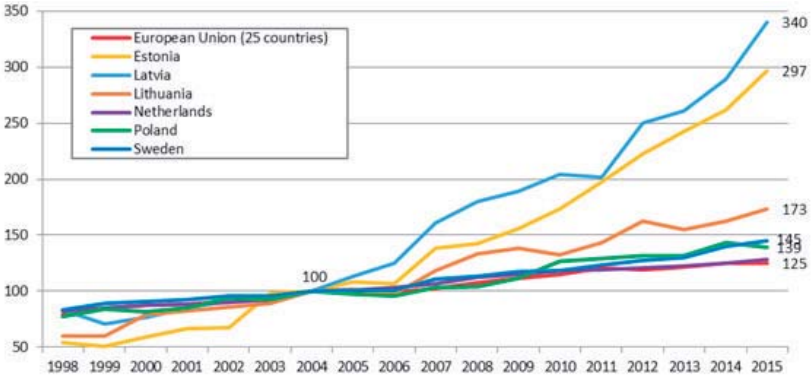

Figure 4. Dynamics of Total Agricultural Output per AWU (working unit) in Poland and in selected EU countries in the period 1998 – 2015 (2004=100). *Source: Authors' calculations based on Eurostat data*

Technological advances in Polish agriculture, productivity increase and positive prices trends in the post-accession period also resulted in increased farm incomes (table 10).

The dynamics of income increase were slightly stronger in the small farms size cluster, but with a very low initial level these farms remain unviable and the personal income of the farmer's family is dependent on income from non-agricultural activities. Greater progress was made in the large farms cluster in the analysed period.

Table 10. Nominal farm incomes in different clusters of farms in Poland

Specification	2004 (PLN/ha)	2012 (PLN/ha)	Dynamics (2004 = 100)
ACCORDING TO ECONOMIC SIZE			
Small	861	1,671	194
Medium	1,539	2,622	170
Large	1,920	3,554	185
ACCORDING TO PRODUCTION ORIENTATION			
Field Crops	1,356	2,661	196
Cattle	1,249	2,174	174
Pigs	2,779	3,771	136
Mixed	981	1,776	180

Source: Authors' calculations based on Eurostat data

Farm incomes have also increased on farm types with different production orientations, largely due to technological advancements, increased productivity and improved quality of farm produce. Pig farms achieved the highest incomes per hectare, but it should be emphasized that their size, measured by the number of hectares of agricultural land is, on average, the lowest.

Environmental aspects of structural changes in Polish agriculture

A clear indication of the impact of the changes that have occurred in agriculture on the environment is very difficult, especially if the analysis is made for a relatively short period.

Changes that have taken place in Polish agriculture have had mainly positive effects in terms of the relationships between agriculture and the natural environment.

Undoubtedly, the introduction of EU legal regulations after accession

to the EU, imposing farming practices which reduce externalities (e.g. Nitrate Directive, greening of the CAP), as well as different support measures, have played an important role in promoting activities that provide environmental public goods and other environmental benefits.

The modernisation of agricultural production and technological advancements might also be beneficial for the environment due to the use of safer, better quality means of production applied with a greater precision.

There are concerns that concentration in the agricultural sector and intensification of production, which have taken place in Poland, may have created threats to the natural environment. This might possibly be true on a relatively small number of farms with a very high concentration of livestock, because of increased emissions of greenhouse gases and problems with manure management. On the other hand, there is evidence, "that larger size, intensive farms can achieve high economic and environmental sustainability level(s) if properly managed" (Majewski, 2013). The level of inputs in agricultural production in Poland, even on more intensive farms, is still far below the levels typical for the most intensive farming systems in Europe. It seems, then, that an appropriate question is, what are the limits to the "smart" intensification of agricultural production.

Developments in recent decades show growing environmental awareness of Polish farmers who have introduced more environmentally friendly technologies and farming systems. For instance, it is estimated that measures funded by the Rural Development Plan that encourage more sustainable models of agriculture were implemented on about 107,000 holdings which introduced environmentally friendly practices, beyond the basic cross-compliance requirements, on a land area of 2.6 million hectares.

After accession, largely due to EU subsidies, but also growing demand, a noticeable growth in the number (and area) of farms that converted to organic production can be observed (figure 5).

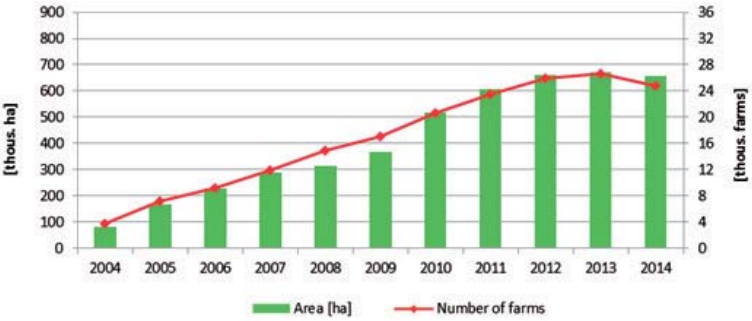

Figure 5. Number of farms and area involved in organic production in Poland 2004-2014. *Source: Authors' calculations based on Main Statistical Office [GUS] yearbooks*

Also Integrated Production, which is considered to be an environmentally friendly farming system, is gaining the interest of farmers, as illustrated in table 11.

Table 11. Number of farms and area involved in integrated agricultural production in Poland

Specification	2005	2010	2012	2013	2014
Number of holdings					
Reported	4,443	1,405	2,742	2,671	2,953
With certificate	1,557	1,068	2,465	2,898	3,178
Certified area in hectares	9,286	7,589	15,443	18,317	19,380

Source: Rocznik Statystyczny Rolnictwa 2015

In table 12, the environmental performance of Polish agriculture is characterized with a set of indicators available from the mass statistics. It shows that the increasing intensity of production and on-going concentration processes have had no harmful effects on the natural environment. It is estimated that agricultural land areas in Poland are characterized by high biodiversity in comparison with other countries (Parris, 2007). In Poland, biodiversity is shaped by a relatively large area of forests (ca 9 million hectares), of wetlands (1.8 million hectares), including 455 thousand hectares of inland waters. Agriculture contributes to the biodiversity of the country due to its diverse production structure and fragmented farm structure. On the other hand, some of the indicators worsened after accession to the EU in 2004, resulting from a shock-type decline in the intensity of agricultural production in the preceding years. The average nitrogen balance of in Poland increased from 39.2 kg of nitrogen per ha of agricultural land in 2004 to 54.9 kg/ha in 2014. This is a much lower value, however, in comparison to the average Nitrogen balance in other countries (Zegar, 2013). An increasing trend was also observed in the case of GHG emissions from Polish agriculture, however when recalculated per 1,000 PLN of agricultural production, emissions decreased by 38% in the period 2004-2014. In the years after 2010 the indicators presented in table 12 have largely stabilized.

Table 12. Selected environmental indicators characterising Polish agriculture 2004-2014

Specification	**2004**	**2010**	**2012**	**2013**	**2014**
Biodiversity index	n.a.	432	440	447	475
Farmland Bird Index	84.9	86.9	84	83.8	n.a.
Production of renewable energy [GWh]	3,074.4	10,888.8	16,878.9	17,066.5	18,678.7
Emissions from agriculture: CO_2, methane, NO_x [thousand tonnes]	450.0	656	627.1	661	656

Emissions from agriculture in kg of greenhouse gases per 1,000 PLN of gross agricultural output	9.95*	7.76	6.08	6.06	6.23
Use of Fertilisers NPK [Kg/ha]	123.3	119.2	133	132.9	133
Nitrogen balance in agricultural land [kg/ ha]	39.2	53.2	49	54.9	n.a.
Nitrogen balance [thousand tonnes]	640	824	733	802	n.a

** for the year 2005*

Source: Authors' calculations based on Main Statistical Office [GUS] yearbooks

Although there has been no formal environmental impact assessment for Polish agriculture, fragmentary observations and scientific evidence permit the conclusion that the situation in Polish agriculture, in terms of environmental impact, is positive. However, it must be emphasized that the agricultural sector in Poland faces some important environmental challenges, such as:

- preserving biodiversity and habitats for wild animals;
- protecting scarce water resources;
- finding smart ways of intensifying agricultural production without negative environmental impacts;
- enhancing the public amenity value of Natura 2000 areas;
- enhancing more environmentally friendly practices, e.g. precision agriculture or integrated production;
- adjusting to climate change, including developing small-scale water retention.
- Formulation of clear environmental objectives and finding appropriate measures to meet them will be needed.

Summary
Developments in the agricultural sector in Poland after 1989, to a large extent policy driven (transition to a market economy, EU accession and the introduction of the CAP, followed by financial support) resulted in significant changes in all dimensions of the agricultural structure. Polish agriculture is characterized by a large number of farms and strong fragmentation of the farming sector, but the number of farms is considerably decreasing and the concentration of agricultural land is noted. Agricultural land is becoming mainly in the size cluster of the largest farms (50 hectares and more) while the change in the area of smaller farms is negative.

The characteristic feature of the animal production sector is the concentration of livestock. The smallest sized herds have continued to disappear, and livestock has moved to larger scale herds on specialized farms. Regarding the cropping structure, this is dominated by cereals, which share in arable land in the consecutive years increased from 60% to 73%.

A significant increase in investments in fixed assets in the years that followed accession to the EU should be noted. The investment processes increased the value of fixed assets in the agricultural sector, although the investments were concentrated in the larger, economically viable clusters of farms.

In response to market requirements, and due to the modernization processes that took place in Polish agriculture, the total agricultural output has consistently grown over a long period. Technological advancements in Polish agriculture, productivity increases and positive prices trends in the post-accession period have also resulted in increased farm incomes. A noticeable increase in agricultural output and incomes in a selection of the new EU Member States after acces-

sion shows the importance of the financial support available due on the introduction of the Common Agricultural Policy and new market opportunities as a result of growth in domestic demand and increased exports. The greatest and impressive progression was achieved in the Baltic republics (Latvia, Estonia and Lithuania), but also indices for Poland are well above the values at the whole EU25 level.

It can be concluded that Polish agriculture is becoming more friendly to the environment, but still faces important environmental challenges of the future.

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TOWARDS ENVIRONMENTALLY SMART AGRICULTURE – CASE STUDY OF LENINGRAD OBLAST

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Introduction

The agricultural sector of Leningrad Oblast has been one of the most dynamically developing sectors of the regional economy over the last 12 years.

The agricultural sector achievements are a combined result of the long-term efforts by experts in the field and in science, supported by the executive authorities. The gross output of agriculture from 2014 was worth 84.9 billion roubles, or 101.3% of the 2013 prices.

The structure of the agricultural sector in the Leningrad Oblast is 526 large and medium-sized enterprises under various forms of ownership. Of these: 256 are agricultural enterprises, 10 feed factories, 113 enterprises of the food and processing industry and 147 enterprises are from the fishery sector. There are five agricultural consumer cooperatives, nearly 1,000 individual peasant farms and more than 104 thousand personal subsidiary farms.

Leningrad Oblast provided 41.4% of the gross output of agriculture of the Northwest federal district in 2014. Thus, the region is the main food producer throughout the Northwest. Nationally, the Leningrad Oblast produces 2% of the total agricultural production volume of the country.

The main agricultural specialization of the Leningrad Oblast is the livestock sector (68% of gross output). The primary branch of agriculture is dairy cattle husbandry but also, for many years, consistently good results have also been achieved in poultry farming. Pig-breeding also has good prospects.

Description of the agricultural sector.
In 2013, according to the Russian Federal State Statistics Service, agricultural output in Leningrad Oblast (here onward referred to as the Oblast) was worth 70.6 billion roubles, of which crop production contributed 22.1 billion roubles and livestock production 48.5 billion roubles.

In 2013 the index of production was: farming sector - 103.7% (in 2012 - 108.1%), crop sector - 106.4% (105.1%), livestock sector - 102.6% (109.5%). Of the all-Russian agriculture production of 3,687.0 billion roubles the Oblast's contribution in 2013 was 1.9%.

In the Oblast a significant portion of agricultural production is focused on the agricultural organizations - 75.1%, while on farms this is 22.8%, and on individual peasant farms 2.1%. In the Oblast production consisted of: grain – 108,600 tons (108.5% compared to 2012), potatoes - 296,300 tons (92.2%), vegetables - 252,500 tons (94.5%), cattle and poultry (live weight) - 349,300 (108.7%), milk - 556,700 tons (97.7%), eggs – 3,170.4 million eggs (102.5%). The Oblast's agriculture share in the gross regional product was 5.5%.

In 2013 the average monthly salary in the agriculture sector of the Oblast was 24,421.9 roubles (1.6 times higher than the average Russian level, 83.2% of the average in the agricultural sector). In the Russian Federation the average monthly salary in the agricultural sector is 15,145.6 roubles (50.8% of the average salary throughout

the Russian Federation). The leading branches of the agricultural sector of the Oblast are dairy and beef farming, potato farming and vegetable farming. Private subsidiary farms provide a considerable part of the potato and vegetable harvests. The main green crops are cabbage, carrot, cucumber, onion and beetroot. Such grain crops as barley, rye and oats are grown in the Oblast mainly as feed for cattle and poultry. In addition, fur farming is developing: mink, muskrat, blue and silver foxes and other animals.

Agricultural areas of all categories constitute 640,000 ha (of which arable land is 337,000 ha). In the Oblast there are over 500 large and medium-sized agricultural enterprises (in the past they were state farms, nowadays they are joint-stock companies). Farms have not yet become popular for investment.

According to the state statistical data, in 2014 in farms of all categories, 565,900 tons of milk (101.7% of the 2013 level), of which the agricultural organizations contributed 523,700 tons (101.9% of the 2013 level) were produced, at an average dairy production of 7,631 kg (247 kg above the production level of 2013), which exceeds the all-Russian index by more than 40%. This increase in milk production was achieved due to stable growth in the dairy efficiency of cows. The Leningrad Oblast has one of the best breeding bases in the country; 62 livestock enterprises for milk production are breeding farms, including two breeding enterprises which have the breeding stock for two breeds: The Golshtinsky breed and the Black and White breed. The breeding enterprises in the region contain 79% of the cows in the Oblast and they produce 84% of the milk.

In 2014 the number of dairy nanny goat was unchanged and there were 1,907. Of the dairy goat breeding stock, 93% are of the Zaanensky breed. In 2014 the agricultural organizations of the Oblast produced

1,245 tons of goat milk (113% of the 2013 level) at an increase of average dairy yield of 6%, to 645 kg.

Beef cattle breeding is most commonly represented by the Aberdeen Angus breed, at 86%. The interest in beef raising among farmers, should be noted. The main focus of beef cattle breeding currently is breeding. Beef production (for slaughter in live weight) in farms of all categories constituted 28,200 tons (96.9% in comparison to the 2013 level), including 23,700 tons from the agricultural organizations of the Oblast (101.3% in comparison to the level of 2013). High-quality beef produced was 8,500 tons (116% in comparison to the level of the previous year). By the end of 2014 the pig population in the farms of all categories was 191,700 (100.5% of the 2013 level), which includes – 183,300 thousand units in the agricultural organizations (101% of the 2013 level). Pork production on the farms in all categories produced 38,600 tons (115.6% of the 2013 level). Of the agricultural organizations 359,190 pigs were grown for slaughter which represented 36,000 thousand tons of meat (118.4% of the 2013 level). The breeding pig population by the end of 2014 increased up to 9,641 units (146.4% of the 2013 level). In 2014, the poultry breeders in the Oblast produced 451 eggs and 31.3 kg (carcass weight) of poultry meat *per capita* of the two regions (The Leningrad Oblast and the city of St. Petersburg). The two regions are self-sufficient in: eggs – 161.4%, which is 57.5% higher in comparison to the Russian indicator (norm of 290 eggs); poultry meat – 104%, which is 8% higher compared to the Russian index (norm of 30 kg of carcass weight). The measures for success for regional poultry farming are to increase bird productive efficiency, strictly control net costs, profit growth, expand product range and provide a high premium quality product.

The main honey producers in the Oblast are personal subsidiary farms (95.6% of all production), individual peasant farms (2.9%) and agri-

cultural organizations (1.6%). The honey output in 2014 in farms of all categories produced 1,404 tons (100.5% of 2013 level). The number of honey-bee colonies in 2014 reached 33,838 (102% of the 2013 level).

The crop sector of the Oblast produces 35.5% of the total volume of crop production in the Northwest federal district and 1.3% of the total production of the Russian Federation.

The Oblast, according to its geographical position, is a zone of risky agriculture. The total area of agricultural land in the Oblast is 1,703,300 ha: forest land area occupies 848,500 ha (49.8%), agricultural production 617,600 ha (36.3%) (which includes 359,900 ha of arable land.

The current situation within the crop sector of the Oblast is aimed at the introduction of innovative technologies for the preservation and increase of soil fertility, crop yields, labour productivity and mechanization of labour-intensive processes and reduced dependence on climatic conditions.

In the structure of the total crop area in the Oblast, most is occupied by forage crops, 164,000 ha or 72% of the total area. Perennial grass occupies 90% of the land area of forage crops. In 2014, 24.9 centners of fodder units per head of cattle were stored.

The average productivity of grain crops in the agricultural enterprises of the Oblast in 2014 was 33.3 c/hectare (+2.6 c/hectare compared to that in 2013).

Total acreage of potatoes in all categories of farms was 16,200 ha. The majority part of which is concentrated in personal subsidiary farms -11,100 ha (69%). The agricultural enterprises and farms grow potatoes on an area of 5,100 ha (31%). Total potato harvest in all cat-

egories of farms was 285,000 tons (96.2% in comparison with 2013), productivity was 176 c/hectare.

Vegetable farming in the Oblast is presented by vegetable growing both in- and outdoors. The land area of vegetable growing outdoors is 7,600 ha (2,700 ha (36%) of which belong to the agricultural enterprises). The main volumes of vegetables are grown in 10 enterprises close to the city. Total vegetable harvest outdoors in all categories of farms produced, in 2014, 210,200 tons (103.8% compared to 2013), and productivity was 337 c/ha. In the agricultural enterprises the total harvest was 132,800 tons, and productivity 490 c/ha. The main provider in meeting the needs of the population for fresh vegetables out-of-season in our region is greenhouse vegetable farming. In the protected soil in all categories of farms 52,200 tons of vegetables: cucumbers, tomatoes, peppers, aubergines and herbs, of which, including the agricultural organizations, 22,200 tons are produced. In the Oblast there are five greenhouse complexes with a total area of 48.5 hectares.

Vegetables are not the only indoor crops from the Oblast. White mushrooms are grown by the Stud Farm Prinevskoye, on an area of 0.636 hectares, throughout the year. The volume of mushroom production remains at the level of the previous year – 1,200 tons. AVK Company (in the Gatchina area) grows oyster mushrooms (150–200 tons per year).

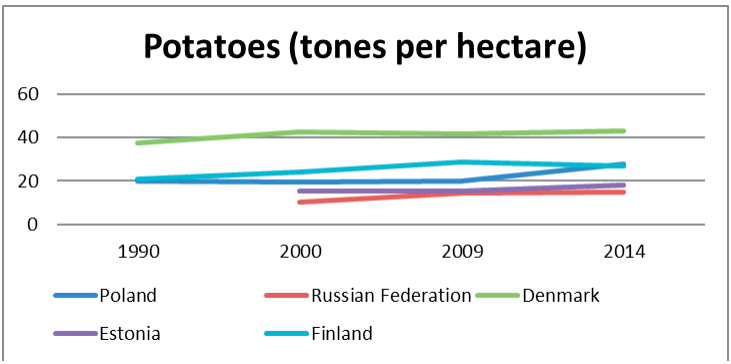
In recent years indoor garden production has developed successfully in the Leningrad Oblast. Such companies as New Holland, Agroleader, Raduga grow roses and other flowers in pots on an area of about 16.3 ha. In 2014 these enterprises grew 29 million roses in total.

Economy

The Leningrad Oblast is one of the few regions of Russia which has been able to keep the commodity producing sector in the conditions existing following the reforms. Of the total production, 74.1% is produced in the agricultural enterprises, and in meat production the share of agricultural enterprises produces 97.6%, milk 92.4%, grain 95.7% and eggs 99.1%.

Such centralization of agriculture allows achievement of the best results in management from an innovation development viewpoint as well as promoting technical and technological production modernization.

The data tables for crops show that problems of low level agricultural productivity remain in the South and Baltic countries such as Estonia, Poland and the Russian Federation.



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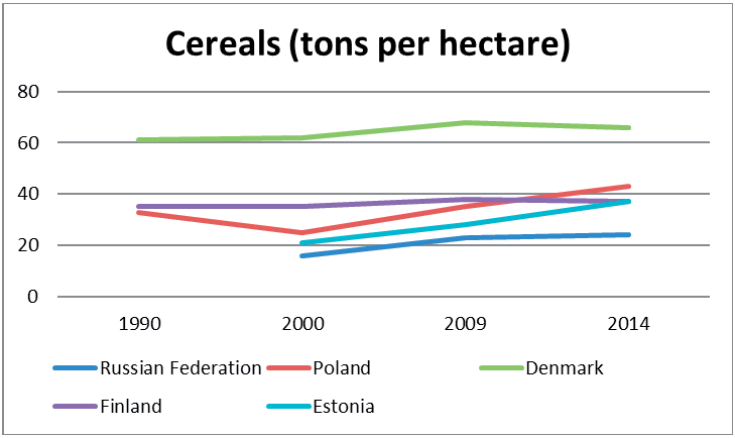

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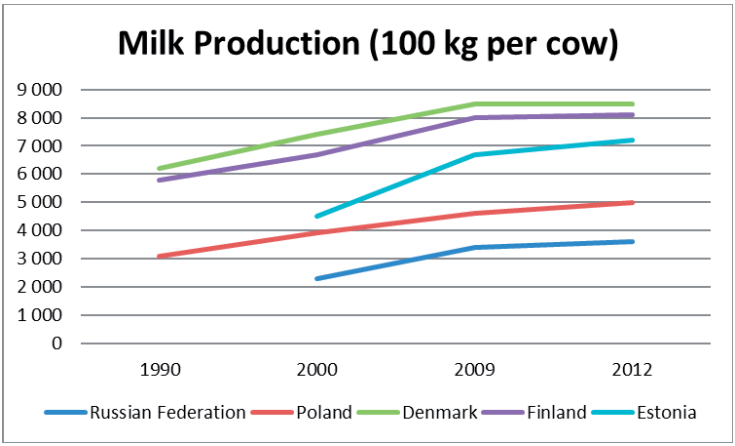

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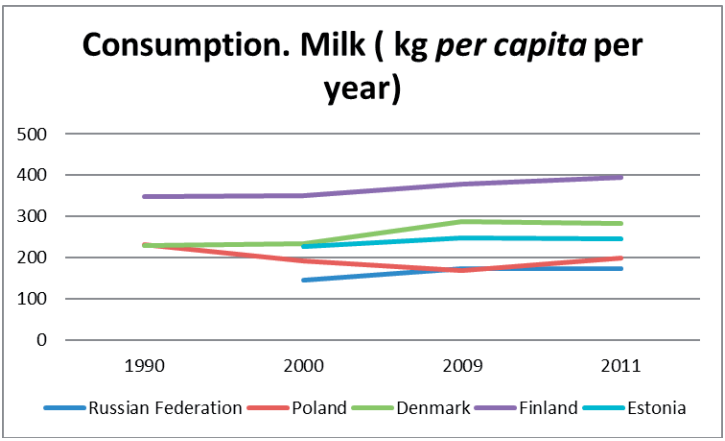
However, it is important to note that high level consumption of agricultural products has stayed at the same rate. This is especially important for the core products of the Baltic region countries.



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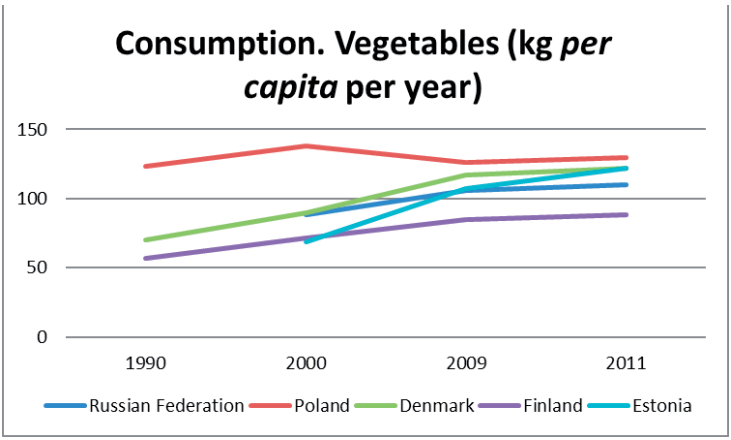
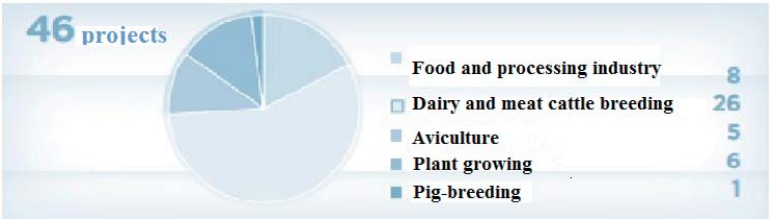


Source: http://knoema.ru/

Investments

Thanks to the implementation of the priority national project "Development of Agrarian and Industrial Complex (AIC)" and the governmental programme of agricultural development, investment was attracted, which has created favourable conditions for increasing agricultural production in the Oblast.

Increase in production through the AIC of the Leningrad region is provided due to intensive technologies and production modernization; 46 investment projects were implemented through the AIC in 2013-2014.



Source: http://www.lenoblinform.ru/mini-sites/agroprom/svedenia/

Governmental support

Stability, increased production and investments have become possible thanks to the attention of the government, both at the federal and the regional levels, to the questions of development of the agrarian and industrial complex.

The main objectives of governmental agrarian policy implementation in the Leningrad Oblast are:

- increase the contribution of the agrarian and industrial complex of the Leningrad Oblast to the solution of food security problem in the Russian Federation;
- increase of competitiveness of products produced in the agro-

industrial and fishery complex of the Leningrad Oblast;
- strengthening of the positions of AIC organizations in the Leningrad Oblast in the interregional food markets, taking into account that the Russian Federation has joined the WTO;
- increase of rural landscape sustainability.

Due to Russia joining the World Trade Organization (August 22nd 2012) the role of state regulation in the agrarian and industrial complex has increased. For the solution of this task not only such tools as the financial budget, but also the State programme of the Leningrad Oblast "Development of agriculture of the Leningrad region", approved by the resolution of the government of the Leningrad Oblast on December 29th 2012 No. 463 are used. In order to implement this program 67.28 billion roubles have been allocated from federal, regional and municipal budgets and from non-budgetary sources.

The amount of state support for the agro-industrial complex of the Leningrad Oblast in 2014 grew by 12% in comparison to the level of financing of 2013, and totalled 5.86 billion roubles.

Taking into account the sub-programme "A sustainable development of rural territories of the Leningrad Oblast for 2014-2017 and for the period till 2020" state support for agricultural development in 2014 was 7.5 billion roubles from the federal and regional budgets.

Human resources

Thanks to the measures made by the Committee over the last six years regarding the provision of social support to young specialists that are employees of the agrarian and industrial complex, and implementation of the programmes aimed at the development of the social infrastructure of rural areas and improvement of living conditions of young specialists there has been growth and updating of the potential

of personnel in this area. Of these personnel 14% are young people aged under 30 (2,520 people), and among them 785 hold top and expert positions. In 2008 the number of young specialists was only 7%.

The results of analysis of the capacity of personnel demonstrate that today's provision of agrarian and industrial complex of the Leningrad Oblast with top managers and experts in the top and middle management makes 92%. The personnel of productive professions makes 90% of regular and standard requirement. The sector is very attractive for young specialists.

Mineral fertilizers

In 2013 agricultural producers of the Leningrad Oblast applied 9,300 tons of mineral fertilizers (700 tons less, than in 2012).

The terminal for fertilizer transfer, the "Smart Bulk Terminal" in the port of Ust-Luga, began operations on June 16th 2015. The total amount of investment in the project amounted to 650 million roubles of self-financing and funds raised from the PhosAgro companies (70%) and "Ultramar" (30%). The terminal complex is capable of handling more than 1.5 million tons of mineral fertilizers a year. Single storage capacity is about 80,000 tons. A feature of this project is that if necessary it is possible to double capacity quickly, both for single storage, and the total transfer capacity.

Conclusions

Main problems and challenges for Russia:

- long term innovation implementation,
- the lack of productivity of the agricultural sector as a whole,
- poor land,
- transport infrastructure problems,
- the lack of factories for agriculture product processing (primarily

milk) into products with high added value (principally cheese, butter and other dairy products),
- the lack of local forage production.

The Baltic region as a model for interactions between the Russian Federation and the EU within the framework of the agrarian and industrial complex.

Russia is a favourable sales market for Baltic countries' products; it is a basis of economic stability for all the countries of the Region. The Baltic countries and Poland are suitable places for Russian investment (particularly for technologies development and commodity distribution in EU countries).

These are workplaces suitable for smart capital application (both from the EU, and the Russian Federation) as well as technological distribution in the territory of the Baltic countries and Russia.

Ecological sustainability is also important, since new "eco-friendly" technologies reduce the level of pressure on marine and coastal ecosystems (one of the most eutrophic basins of Europe) and encourage the development of organic agriculture, agricultural tourism, bioenergetics, etc.

For this purpose, it is necessary to harmonize the ecological and economic legal backgrounds as well as to implement unique indicators and standards. As a result, research work for the comparative indicators with the aim of advancing standards and structure of the agrarian and industrial complex organization is needed (in Finland, Sweden, Denmark and Norway). What is more, training courses are also a necessity. Finally, one more important issue is the search for solutions for mutual understanding in

the political sphere and the search for economic compromise.

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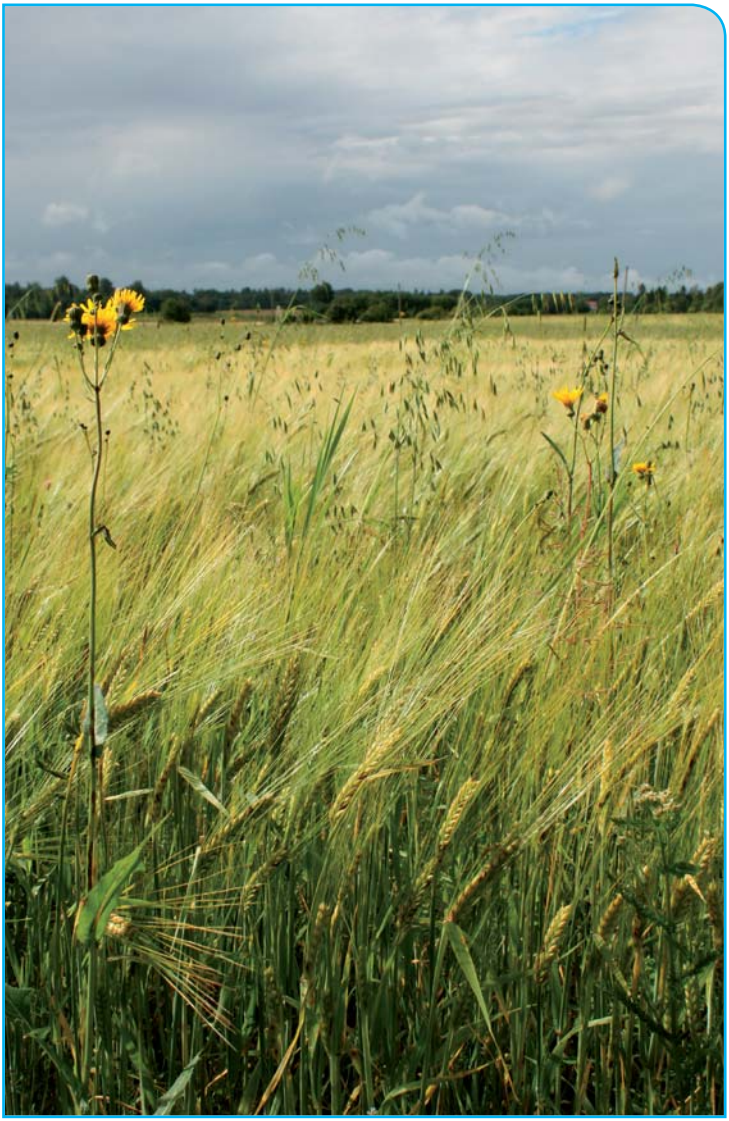

Agroforum 2016
Mare Balticum

CONFERENCE ABSTRACTS

ADDRESSING THE CHALLENGES OF SUSTAINABLE FOOD SECURITY AND CLIMATE CHANGE THROUGH CLIMATE SMART AGRICULTURE

Raimund Jehle
Food and Agriculture Organization of the United Nations

Climate Smart Agriculture (CSA) is an approach to develop technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. CSA aims to optimize the multiple objectives of: (1) sustainably increasing agricultural productivity and equitable increases in incomes; (2) adapting and building resilience of agricultural and food systems to climate change; and (3) reducing the negative impacts of agriculture, in particular greenhouse gas emissions.

CSA is not an agricultural practice or system per se, but is location-specific. It identifies and combines the most suitable and sustainable practices and solutions for the local economic, environmental and social circumstances. CSA is applied across scales (from national down to farm level); across sectors and along whole food value chains. It uses an ecosystem approach for the better management of ecosystem services, such as carbon storage, biodiversity conservation and freshwater cycling. It combines farm and landscape interventions with the creation of the necessary enabling environment (such as policy, financing and access to services) to allow farmers to make the necessary CSA transitions.

At the core of the CSA approach are the principles of food and nutrition security and the empowerment of farmers, especially smallholders, to transition to profitable as well as sustainable agricultural systems. Within these systems, various CSA practices and technologies exist,

such as conservation agriculture, agroforestry, improved livestock and water management, which are in line with the European Union's (EU) Common Agricultural Policy's (CAP) agricultural and environmental standards. Since the CAP's payment scheme's reform of 2003, farmers are provided with incentives if they adhere with the practices reductions e.g. soil erosion, structure and organic matter, plant health and animal health and welfare ('cross compliance'). The EU has thus recognized that developing agriculture also needs to support the provision of public goods, such as environmental sustainability and protection.

However, recent studies[1], have noted that CAP implementation in the Baltic Sea Region, during the period of 2007 to 2013, has often not resulted in a significant reduction in environmental impacts from agriculture. Climate Smart Agriculture therefore provides a means to optimize agri-environmental and other measures as well as improve effective monitoring as well as cross-sectoral coordination between the agriculture and environment sectors.

[1] SEI. 2013. Policy Brief. The Common Agricultural Policy Post-2013: Could Reforms Make Baltic Sea Region Farms More Sustainable? Key Findings.

HOW EUROPE'S COMMON AGRICULTURAL POLICY PROMOTES SUSTAINABILITY AND INNOVATION

Joost Korte
European Commission

Europeans have high expectations from agriculture. We want to be sure that food is safe and of good quality and we also expect that farmers remain competitive in the world market. We want farmers to preserve the countryside and biodiversity but we also expect that agriculture will be able to feed the growing population with its changing dietary patterns. And we also expect that agriculture will make a contribution towards global challenges such as climate change. The Common Agricultural Policy (CAP) is Europe's tool to meet these expectations.

The CAP's innovation policy is focussed on increased productivity and resource efficiency, which are essential to maintain our competitiveness and market orientation; only with a profitable primary production sector can EU agriculture defend its current favourable position on the world market. However, this increase in productivity must not be at the expense of natural resources. The CAP therefore also promotes sustainability, including greening of aid payments through both of its pillars. A key challenge will be how to further enhance the sustainability of EU agriculture and promote the use of new technologies, farm and land management practices and new strategies of cooperation to pave the way in this direction.

The key areas of common approach are shown in the following chart. The two pillars interact in financial terms, with possible transfers between both and rules to prevent double-funding.

PILLAR I	TARGETED ACTION	PILLAR II*
Green payment	**ENVIRONMENT**	Agri-environment-climate Organic, Natura 2000
Top-up payment	**YOUNG FARMER**	Business development grants Higher investment aid
Top-up payment	**AREAS WITH NATURAL CONSTRAINTS**	Area payments
Alternative simplified scheme	**SMALL FARMER**	Business development grants
Improved legal framework	**PRODUCER COOPERATION**	Aid for setting up producer groups Cooperation and short supply chain

*Only main measures that target the specific issue under Pillar 2 are mentioned.
Source: DG Agriculture and Rural Development.

DATA IS THE NEW FERTILIZER WE SHOULD USE MORE OF

Martin Rand
VitalFields

VitalFields is the fastest growing Farm Management System in Europe with over half a million hectares under customer accounts. The company is successful internationally due to its flexible localisation architecture and compatibility with government GIS and compliance systems.

VitalFields offers online tools from planning and operational management to compliance reporting for farmers, all accessible from computer and smartphones. Its cloud-based products help farmers do things like plant disease and growth phase modelling, tracking climatic patterns, and other farm management-related activity such as farm planning, stock management and profit and loss reports.

Its aim is to increase the efficiency of its customers. Hence farmers are able to plan in advance what and where to cultivate in the next season and to draw conclusions from previous seasons. In doing so, they save a huge amount of time and have the ability to react quickly to such factors as changes in weather.

Farmers provide VitalFields with valuable daily data on farming practices which is analysed and supplied back as advisory service.

We will give and overview of the experience in VitalFields on how data can enable farmers to grow more with less.

RESILIENCE OF AGRICULTURE TO ENVIRONMENTAL CHANGES: SUSTAINABLE INTENSIFICATION

Liisa Pietola
Central Union of Agricultural Producers and Forest Owners (MTK), Working Party on the Environment at Copa-Cogeca.

Climate change is a challenge which determines our future environmental policy, globally and in the EU. Remarkable steps were taken in December 2015, at the Paris climate negotiations, which aimed at a legally binding and universal agreement to reduce climate warming. The outcome gave strong support for food security, and called for carbon sequestration – a key for resilience.

Sustainable intensification aims to store carbon dioxide from the atmosphere. Besides good yields, it produces plenty of soil organic material: roots and debris. These materials are essential to maintain soil fertility, control erosion, and store carbon. By growing biomass, we have the potential to heal the climate, waters and soil ecosystems to ensure resilient food production.

Article 2 of the Paris agreement calls for strengthening of the global response to the threat of climate change, by "increasing the ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production". In Article 5, the agreement encourages "action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases".

These crucial messages of the Articles should be in line with the EU climate policy framework after 2020. In the current policy framework,

agriculture is evaluated in the non-ETS sector with non-CO_2 gases, nitrous oxide (N_2O) and methane (CH_4). In Finland, our target is to reduce 13 % of these gases by 2020, from 2005. There is, however, scientific evidence that this target is far too ambitious and is not cost-efficient. Only 1/8 of the target can be reached through cost-efficient measures (Rikkonen, ed. Luke 2015: ISBN: 978-952-326-044-3).

Carbon is not accounted for. How to include carbon? How to promote sustainable intensification and productive soils with high potential for carbon removal? By reduced tillage, crop rotation and crop cover we could sequestrate and store soil carbon and produce more food, and feed. with less land use. There are data showing that soils with high yields emit less nitrous oxide than un-productive soils. Also, crop cover reduces nitrous oxide emissions, especially from grasslands. Therefore, we need animals as a part of sustainable agriculture. In sustainable intensification, we need to acknowledge protein production by ruminants along with leguminous crops, as well as their methane emissions.

Overall, we need to recognize cycles of elements and the time horizon: carbon from methane emissions by ruminants will be sequestrated later by crops. There is no need to reduce agriculture production to save the environment. Contrarily, sustainable agriculture will save the globe, through photosynthesis and the circulation of elements.

ENVIRONMENTALLY FRIENDLY RURAL TOURISM – ADDED VALUE TO AGRICULTURE

Reve Lambur
Rural Economy Research Centre

One possibility to be more sustainable in agricultural production is to find ancillary activities compatible with agriculture and new ways for consumer product marketing.

That is why the Open Farm Day was launched, in cooperation between the public and private sectors in Estonia. The second Open Farm Day will take place on 24 July 2016.

Open farm days are organised in several countries all over the world with a view to attracting townsfolk and demonstrating the origin of quality food. It is also important to explain the essence of rural tourism to agricultural holdings. The first all-Estonian Open Farm Day proved to be more successful than expected and attracted tens of thousands of interested people – more than 44,000 farm visits were made and 147 farms opened their gates.

In March 2016, the Estonian Public Relations Association (EPRA) announced the all-Estonian Open Farm Day, which for the first time took place in July 2015, best place in their PR Awards Competition.

MODERN LIVESTOCK SYSTEMS – ECONOMIC AND ENVIRONMENTAL CHALLENGES WHEN FACING EPIDEMIC DISEASE OUTBREAKS

Prof. Arvo Viltrop
Estonian University of Life Sciences

The advancements in livestock husbandry in developed countries in recent years have shown a tendency towards the concentration of production into larger production units, more industrialised production systems, the application of smart (computerised) solutions for precision livestock farming and the involvement of less and less man power at every step in production.

Along with the concentration of livestock production, the integration of primary production (farming), processing of animal products (meat, milk and egg processing plants) and marketing (wholesale and retailing) in corporate enterprises, often at a transboundary scale, have become the reality in many countries.

These developments have created a new reality in regards to the control of serious epidemic animal diseases, both in the sense of applying measures to prevent the introduction of infections and (particularly) in the situation when such a disease has already entered the territory of a country or a region.

The recent epidemic of African swine fever (ASF) in Estonia has shown how vulnerable the present economic model of pig production is to challenges created by disease outbreaks, causing restrictions to the movement of animals and meat as a result of the application of official disease control measures.

On the other hand, outbreaks of the disease on large animal units, alongside enormous economic losses, create a serious environmental crisis, as the removal of thousands of tons of animal carcasses and contaminated materials, in a very short time period, is not possible without harming the environment in one way or another.

The consequences of the present outbreak of ASF for Estonian pig industry, the challenges and possible solutions are discussed.

CHALLENGES IN THE GLOBAL FOOD SYSTEM

Giuseppe Fantozzi
Global Practice for Food and Agriculture, The World Bank

The food system is fundamental for human life. It provides the energy and nutrition that people need as a basis for economic and social advancement. It provides an income source for billions of people, many of whom are poor, and it is the largest user of the world's natural resources.

The historical evolution of the global food system has enabled the present day rapid urbanization and population growth, contributing significantly to welfare improvement in the world. However, the positive impacts on poverty and shared prosperity have not been universal. Despite significant progress, about 800 million people still go to bed hungry every night, and many more suffer from the "hidden hunger" of micronutrient deficiencies. More than 2 billion people are deficient in the key vitamins and minerals necessary for human development and preventing diseases. The great paradox today is that another 2 billion people globally are overweight or obese, two-thirds of whom live in developing countries.

By 2030, world food demand is projected to increase by 20% with consumption shifts towards non-cereal products and urbanized regions in developing countries. Global food demand will become increasingly urban, as 60% of the world population resides in urban centres. The world will also feel the impact of changing dietary preferences. In particular, demand for animal proteins, processed food products and, to a lesser extent, fruit and vegetables will increase. It is estimated that by 2030, the demand value for fish, milk, meat and vegetables (US$ 348 billion) will be five times the aggregate value for rice and other cereals (US$ 70 billion).

Climate change adds to this challenge by increasing the short term climatic and production volatility, causing medium term yield losses and resulting in major production declines in the longer term. We urgently need a food system that is more resilient to these climatic events, and that shifts from being a major contributor to climate change to being a part of the solution in addressing climate change. A more climate-smart agriculture is needed to address productivity, resilience and reduce emissions. Some work is already on-going to identify Climate-Smart agriculture practices in North America and Europe including the use of biodigesters, optimizing fertilizer use, improving supply chain management and reduction in waste. In Africa, some examples of CSA practices include agroforestry, improved pastures and integrated nutrient management.

Increased trade within and across countries can help increase the responsiveness of the food system to shocks and dampen food price volatility. This calls for increased attention to marketing, logistics, food safety and reducing food loss and waste. Policies are needed to help facilitate, not hamper, trade.

To permanently end poverty and hunger by 2030, the world needs a food system that can feed every person, every day, everywhere, that can raise real incomes of the poorest people, that can provide safe food and adequate nutrition and that can better steward the world's natural resources. All these aspects are closely interlinked, calling for a more comprehensive approach to delivering a healthier and more prosperous future.

PROTECTING BIODIVERSITY IN AN AGRICULTURAL LANDSCAPE

Dr. Peter D.Carey
University of Cambridge and Bodsey Ecology Limited

Some of the most diverse wildlife habitats in Europe are found on managed agricultural land. In particular, the old pastures, grazed and cut for hay over many centuries, stand out, as do ancient well managed woodlands and forests. The intensification of agriculture in the latter half of the 20th Century undoubtedly had a negative impact on the wildlife that lived in those landscapes. The cleaning of cereal seeds has almost wiped out wild flowers that inhabited arable fields, although it must be said that the injurious weeds that cleaning was intended to remove were largely eradicated. The reseeding of ancient grassland, the addition of fertiliser and the move to silage production have caused major losses of habitat. For example, there has been a 95% loss of species-rich neutral grasslands in the UK.

As the memories of the population of starvation faded from the end of the Second World War and food production was secured, the environmental movement made the case for the protection of wildlife in the agricultural landscape. From the beginning of the 1990's agri-environmental measures were introduced to protect what remained, and to create ways in which wildlife could coexist with intensive agriculture. Examples of protected areas were wetlands, where further drainage was prevented, and also on moorland and heath, where grazing was reduced to encourage heather growth. Measures to help wildlife coexist in intensive arable areas included field margins sown with tussocky grasses to encourage ground nesting birds and the insects they eat. Billions of Euros were spent on these schemes, and after some time the funders demanded to know whether the measures were being effective. All of the measures were introduced

with good intentions and were intuitively likely to be beneficial. Unfortunately intuition was not enough, and evidence was required. Most of the schemes across Europe were not monitored effectively, partly because it was not thought necessary but mostly because it was too expensive to do it correctly. It has been easier to show positive impacts for protective measures because the impacts of the measures are quite large and the sample size can be small. For more subtle measures, such as field margins and over-wintered stubbles, the impacts are small and the sample size of monitored sites required to show an impact is huge.

In the last few years the concept of "land-sharing versus land-sparing" has been introduced. Land-sharing is the use of the landscape for agriculture but leaving some of the land in the fields for wildlife. It can be equated with such agri-environment measures as field margins. Land-sparing is where the landscape is divided into areas, where some are used for intensive agriculture but with large areas set-aside for wildlife. The aim is to achieve the same agricultural yields in both land-sharing and land-sparing systems. Originally the idea was proposed for developing countries, where wild areas such as rainforest could be set-aside from the expansion of agriculture. It is less clear-cut how this system could be applied to the European landscape, where truly wild areas do not really exist. However, colleagues have been looking at the implications for biodiversity of land-sharing versus land-sparing in the EU, and especially in the newer states of the EU. In almost all cases land-sparing has a higher benefit to wildlife than land-sharing, especially if woodland is the spared land. As is usual for most conservation studies, the emphasis has been on birds. More research is required to establish whether this new model is good for plants. Land-sparing has the added advantage of being easier to evaluate, as the impacts will be large and the number of monitored sites can be relatively small. Biodiversity should be successful and the funders should see that their funds are being well spent.

CARBON STORAGE IN SOILS: AN INTERNATIONAL, COLLECTIVE AND RELEVANT SOLUTION TO PREVENT GLOBAL WARMING: THE FRENCH 4 PER 1,000 INITIATIVE

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Embassy of France in Poland

Agriculture is a major contributor to global warming but can also be a great help to prevent or reduce it. A solution depends on the increase of carbon storage in soils. Promoting and developing appropriate agronomic solutions and practices is of great importance, either to prevent global warming but also to achieve sufficient world production to cope with an increasing world population. Agriculture is not only a problem regarding global warming but also a solution. This is why the French government has taken the initiative, already part of the framework of the Paris COP 21 conference, of roughly 100 countries, world organizations and NGOs: the purpose is to promote suitable practices and to develop a common approach, both in developed countries or emerging ones, to widen the use of these practices and to create common research programmes at the international level. The aim is to increase the percentage of carbon storage by at least 0.4 % per year (4 per 1,000) which is equivalent to one year of carbon dioxide gas emissions.

In the framework of the Paris Conference COP 21, the French government has taken the initiative to unite any country or NGO in the contribution of agricultural practices in the fight against global warming. The 4 per 1, 000 rate (or 0.4%) is an annual growth rate: the annual rate of increase in carbon burial in the ground that offsets a year of carbon dioxide emissions produced by human activity in the atmosphere.

The initiative is divided into two parts:

- a multi-stakeholders action programme, at state and non-state level, for the better management of soil carbon in the fight against poverty and food insecurity, while contributing to the adaptation to climate change and the mitigation of emissions;
- an international research and scientific cooperation programme - "The carbon in soils: a food security issue".

Agriculture contributes to global warming (particularly through methane emissions from livestock), has undeniable negative externalities (water pollution by nitrates, use of pesticides) and is, by its nature, a high user of water resources: it is often attacked for these and should ensure its practices evolve, both in developed countries and among developing countries, to reduce these negative effects. Common Agricultural Policy (CAP), since its recent reform, includes an orientation towards the greening of support measures for agriculture.

This is also the purpose of the policy of the French Ministry of Agriculture; to support innovative and more environmentally friendly practices, to reconcile maintaining production, lowering costs of production (reduced use of pesticides) and improving respect for the environment, described under the global term agroecology. This is actually a new move in agronomic practices (and therefore non-decreasing). These softer practices have been already documented for some time by specialists in agronomy.

The objective of the initiative is to show that agriculture, far from being only a problem, is also a solution in the fight against global warming, while at the same time it can provide an increase in world food production. It is indeed essential to increase agriculture to cope with the increase in world population and changing food tastes, leading to greater consumption of animal protein as is associated with the economic development of countries. The idea of the initiative is to link food security and climate protection.

Carbon sequestration in soils is one of the solutions put forward: it reduces emissions of carbon dioxide by plant matter in landfill waste, both from the culture that weeds (herbs opportunistic or "weeds") after the crop in the ground, by maintaining a time interval between cultures and by the use of spatial barriers. All of these also improve the organic quality of the soil, by the decomposition of the plants, thereby reducing the risk highlighted by many experts, of a drop in the organic quality of soil, worldwide, due to overuse of intensive agriculture, which can lead to the exhaustion of the soil.

Moreover, burying plants by tillage (which is already often practised in wheat and maize cultivation by the classic technique of grinding/mulching), leads to a reduction in pesticide doses, as the farmer will need to avoid burying pesticides absorbed by the plant during its growth, which would increase soil pollution. Permanent plant cover, either natural or not, can also be a solution. Cultivating several different plant species in the same field can also be a positive factor as this can reduce the need for pesticides.

The 4 per 1, 000 approach allows to reconcile the priorities of different countries both North and South regarding the soil carbon. Indeed, the most carbon-rich soils (and therefore those highest in organic matter) are more fertile, which is beneficial for productivity and food security. Such soils are also resilient to climatic change, as they are more resistant to erosion and retain water better, especially during extreme events such as droughts. Furthermore, this rate is a reference figure, but not a normative framework: it can be adapted to suit the situation in each country and each experience is welcomed.

INTERNATIONAL AGRICULTURAL FAIR MAAMESS 2016

Maamess is one of the acknowledged rural fairs of the Baltic countries, bringing together an international agricultural fair, international wood processing and forestry fair, food fair and gardening fairs. The quality of the fair is ensured through collaboration with the European federation of agricultural exhibitions and show organisers and cooperation with agricultural and rural fairs in neighbouring countries.

The 24th annual Maamess will bring together 450 large and small enterprises on a 50,000 m^2 exhibition space. Every year we have more and more international companies participating and visitors from all over the world. This year the fair will have nearly 50 international companies from ten countries. Last year we had more than 40,000 visitors over three days.

Maamess is organised by AS Tartu Näitused, which has been an experienced fair organiser since 1991.

International Agricultural Fair Maamess 2016 will take place on 21-23 April 2016 in Tartu Exhibition Centre, Estonia.

See more at:

www.maamess.ee
www.tartunaitused.ee

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