Ministry of Agriculture
Republic of Latvia

INFORMATION ON LULUCF ACTIONS IN LATVIA

REPORT UNDER LULUCF DECISION 529/2013/EU ART 10

SUBMISSION TO THE EUROPEAN COMMISSION

Riga 2015

List of abbreviations

AFOLU – Agriculture, Forestry and Other Land Use
CAP – Common Agricultural Policy
CHP – combined heat and power
CSB – Central Statistical Bureau
CP – Commitment Period
EAFRD – European Agricultural Fund for Rural Development
EU – European Union
FMRL – Forest Management Reference Level
FSC – Forest Stewardship Council
GHG – greenhouse gas
HAC – high activity clays
IPCC – Intergovernmental Panel on Climate Change
KP – Kyoto Protocol
LEGMC – State Ltd. Latvian Environment, Geology and Meteorology Centre
LUA – Latvia University of Agriculture
LSFRI Silava – Latvian State Forest Research Institute "Silava"
LULUCF – Land use, Land Use Change and Forestry
MA – Ministry of Agriculture of the Republic of Latvia
MEPRD – Ministry of Environmental Protection and Regional Development of the Republic of Latvia
NAP - National Development Plan
NFI – National Forest Inventory
NIR – National Inventory Report
NRP – National Reform Programme of Latvia for the Implementation of the "Europe 2020" strategy
PEFC – Programme for the Endorsement of Forest Certification
RDP – Rural Development Programme
RSS – Rural Support Service
SLS – State Land Service

Introduction

According to the Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 and its Article 10, Member States shall draw up and transmit to the Commission information on their current and future LULUCF actions to limit or reduce emissions and maintain or increase removals resulting from the activities referred to in Article 3(1), (2) and (3) of the Decision. The activities referred to in Article 3(1) are afforestation, reforestation, deforestation and forest management. Activities in Article 3(2) are cropland management and grazing land management, which Member States shall prepare and maintain annual accounts for. Prior to 1 January 2022, Member States shall provide and submit to the Commission each year initial, preliminary and non-binding annual estimates of emissions and removals from cropland management and grazing land management. According to Article 3(3) Member States may also prepare and maintain accounts that accurately reflect emissions and removals resulting from revegetation and wetland drainage and rewetting. The accounts referred to in paragraphs 1, 2 and 3 of the Decision, shall cover emissions and removals of the greenhouse gases like carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The information on LULUCF actions has to cover the duration of the accounting period of January 1, 2013 – December 31, 2020. In the information on LULUCF actions the following information relating to the activities required in the Decision No 529/2013/EU are:

1. a description of past trends of emissions and removals including, where possible, historic trends, to the extent that they can reasonably be reconstructed;
2. projections for emissions and removals for the accounting period;
3. an analysis of the potential to limit or reduce emissions and to maintain or increase removals;
4. a list of the most appropriate measures to take into account national circumstances, including, as appropriate, but not limited to the indicative measures specified in Annex IV of the Decision, that the Member State is planning or that are to be implemented in order to pursue the mitigation potential, where identified in accordance with the analysis referred to in point (3);
5. existing and planned policies to implement the measures referred to in point (4), including a quantitative or qualitative description of the expected effect of those measures on emissions and removals, taking into account other policies relating to the LULUCF sector;
6. indicative timetables for the adoption and implementation of the measures referred to in point (4).

The Report was compiled by the Ministry of Agriculture of the Republic of Latvia in cooperation with Latvian State Forest Research Institute "Silava" (Senior researchers Andis Lazdiņš and Jānis Donis and research assistant Aldis Butlers).

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Executive summary

The information on LULUCF actions is prepared by the Ministry of Agriculture of the Republic of Latvia (MA) in cooperation with Latvian State Forest Research Institute "Silava". MA had communications with other ministry departments and stakeholders in order to provide complete and accurate data for the submission to the European Commission according to the Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 and its Article 10.

The national legislation in Latvia regulates the environmental and biodiversity protection, sectorial development and sustainable management by the National Development Plan of Latvia for 2014-2020, the Forest Law, Forest Policy (1998), Guidelines of Land Policies 2008-2014, the Environmental Policy Guidelines (2013-2020) and other legal acts.

The forest sector is the key sector in the LULUCF and is regulated by national legislation. In Latvia, national forest policy lays down solid and constant basis for sustainable forest management. Harvesting amount is determined rather by market demand that differs from one year to another, while environmental integrity is always ensured. Also in the future (including the KP 2nd CP) no change in national forest policy is foreseen. However, changes will trigger other policies – the high impact for Latvia particularly is foreseen in the context of the EU's renewable energy targets under the Europe 2020 Strategy.

In the process of communication with the stakeholders, a number of different possible climate friendly measures have been identified and underlined. **However, the quantitative analysis on how all selected measures are affecting greenhouse gas (GHG) emissions reduction is not made yet. Also the measures based on the national legislation have a particular influence on the total carbon budget; however those are not expressed quantitatively.**

The report presents the information on LULUCF actions and it **is focused on the measures of the Latvian Rural Development Programme 2014-2020 (RDP)**[1], additionally national circumstances and the existing and foreseen policies are described.

The RDP 2014-2020 is adopted by the government and approved by European Commission on 13 February 2015. Rural development policy is part of European Union Common Agricultural Policy (hereinafter the CAP) and it is financed from the European Agricultural Fund for Rural Development (EAFRD). The objectives of the rural development policy are rural competitiveness, sustainable management of natural resources and balanced territorial development of rural areas. CAP also sets greening measures.

The most appropriate measures for Latvia that are planned to be implemented in order to pursue the mitigation potential, are described in the following sections, including cropland management and forest management related measures.

Measures related to cropland management are as follows: reconstruction of drainage systems in cropland; establishment of orchards; greening activities; production of legumes as a green manure and source of nitrogen; and crop rotation using green manure.

Latvia is located in an area characterized by a humid continental climate. The annual rainfall exceeds evaporation. Since 19th century considerable area of the country is drained (1.49 million

1 https://www.zm.gov.lv/lauku-attistiba/statiskas-lapas/lauku-attistibas-programma-2014-2020/latvijas-lauku-attistibas-programma-2014-2020-gadam?nid=1046#jump

ha of agricultural land have drainage systems, including regulation of water regime with 53 polders covering 50 thousands ha). Rural development program 2014-2020 has planned reconstruction of drainage system assuming that the measure will cover 16% of the drainage systems. The measure considers improvement of design of the drainage systems to reduce leaching of nutrients into rivers and lakes. Drainage and protection from flooding are mandatory preconditions for resource efficient and sustainable development of agriculture and forestry sectors in Latvia.

Measures related to forest management are as follows: reconstruction of drainage in forest land; afforestation of abandoned farmland; pre-commercial thinning of forests; regeneration and reconstruction of degraded and non-valuable forest stands; maintenance of fire prevention system. The most of support is considered for thinning of forests and reconstruction of non-valuable forests. These measures are important in private forests, where lack of financial resources is hampering forest management, especially thinning and reconstruction of stands, because these operations usually are not profitable.

Enhanced communication

Ministry of the Agriculture of Republic of Latvia (MA) as the ministry is responsible for elaboration of the information on LULUCF actions cooperated with other ministries, researchers and non-governmental organizations in order to provide complete and accurate data for submission to the European Commission.

Close cooperation and information exchange was established with the Ministry of Environment and Regional Development (MEPRD), Rural Support Service (RSS), State Ltd. Latvian Environment, Geology and Meteorology Centre (LEGMC), Latvia University of Agriculture (LUA) and Latvia State Forest Research Institute "Silava" (LSFRI Silava). The LSFRI Silava and MA have main responsibility to provide historical trends and future projections of greenhouse gas emissions and removals in LULUCF sector.

The tasks of the Forest inventory group in LSFRI Silava are to plan, organize and perform the National forest inventory (NFI) and monitoring of land-use and land use change, which is part of the NFI. The applied research necessary to improve GHG accounting in LULUCF sector is done by different organizations, but mainly by the LSFRI Silava and Latvia University of Agriculture. The LSFRI Silava is the main institution in LULUCF sector in Latvia responsible for carbon cycle monitoring, control, process and analysis of the monitoring data, complying national and international reporting obligations in LULUCF sector and according to paragraphs 3.3 and 3.4 of the Kyoto protocol.

In addition to permanent personnel of the involved organizations, several experts from various departments of the MA took part in compilation of the information on LULUCF actions. Coordination of the report compilation was done by the Forest Department and Agriculture Department of the MA.

In the process of communication with the stakeholders, a number of different possible climate friendly measures have been identified and underlined. However, there is no clear, science-based understanding how all of those measures contribute in terms of GHG reduction quantitatively. Among other measures **organic farming** and **the establishment of horticultures and orchards** were the measures that brought the most of attention during the discussions. The measures were considered as such that provide a positive contribution to ecosystems and other cross-cutting benefits, however uncertain in terms of GHG mitigation potential.

Overview of national circumstances

The total area of Latvia in 2014 is 6.46 mill. ha including 6.22 mill. ha of land area. About 52% of the land area is forest (excluding forest infrastructure), 37 % is agricultural land (including 26% of cropland and 11% of grassland), 7% are wetlands, including water bodies, and 4% are settlements. The population of Latvia in 2014 was close to 2 million people. The total nominal GDP of the country in 2014 was 26.204 billion EUR (12 892 EUR per capita). Those Land Use, Land Use Change and Forestry sector is important in Latvia's GHG balance.

In order to meet the future demands of a growing population globally, it may be necessary to increase the area of land that is used for agriculture as well as efficiency of production in order to produce food and energy. Rather than turning to areas that have never been cultivated, it would be preferable to reclaim land that has previously been used as farmland[2]. One of Latvia's specific circumstances which have to be highlighted is unused potential of land resource (e.g. income and added value per ha) which is identified in each of the land use categories. Latvia, just like other Baltic states, is unique in comparison with other member states, because there is still considerable amount of previously used but currently abandoned agriculture land. The most of these lands, except nature conservation areas, can be returned to crop production.

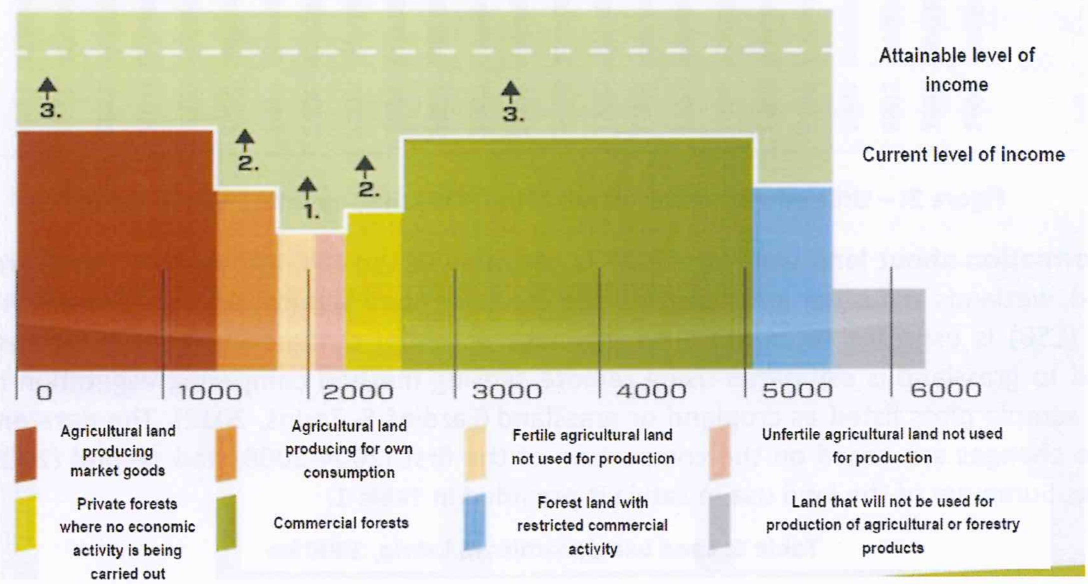

Figure 1: Land analysis according to classification by the Ministry of Agriculture the Republic of Latvia

In accordance to MODIS time series satellite data[3] considerably higher abandonment rates in areas of medium and high suitability for agriculture are characteristic in Latvia, therefore, the potential of increase of crop production is relatively higher than in other EU countries.

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2 Mapping the extent of abandoned farmland in Central and Eastern Europe using MODIS time series satellite data (Published on September 4, 2013)

In Latvia the highest national-level medium-term planning document - the National Development Plan 2014–2020 emphasize "*economic growth strategy*", inter alia recognising sustainable use of natural resources (agricultural land, forest, peatland – for sustainable production of food, feed, fibre and fuel). National target set in the National Development Plan 2014-2020 foresees that by 2020 managed agricultural land share has to be 95% from the total land area that can be used for agricultural purposes.

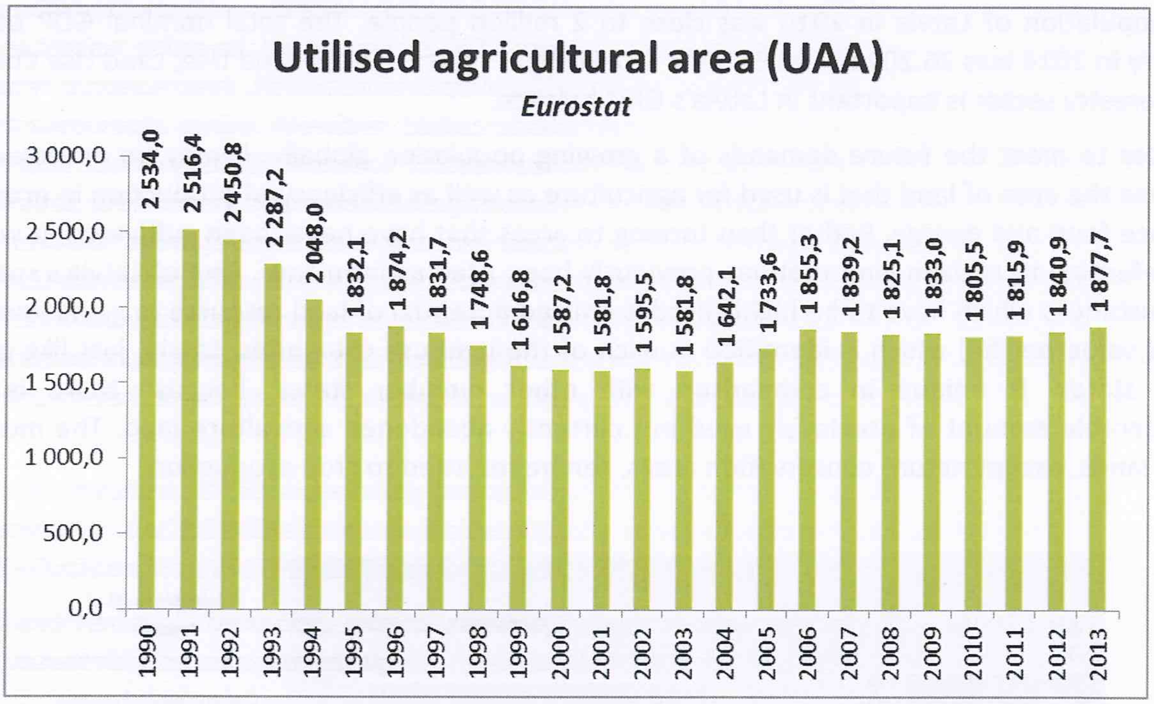

Figure 2: – Utilised area of farmlands (EUROSTST, last update 5 March 2015)

The information about land use since 2009 is provided in the NFI. Information about grassland, cropland, wetlands and other lands provided by the State Land Service (SLS) and Central Statistical Bureau (CSB) is used for reference – to estimate potential outliers in the NFI. Conversion of cropland to grassland is estimated using remote sensing method comparing vegetation index in the NFI sample plots listed as cropland or grassland (Lazdiņš & Zariņš, 2012). The data on recent land use changes are based on the comparison of the first (2004-2008) and second (2009-2013) NFI cycle. Summary of the land use in Latvia is provided in **Table** 1.

Table 1: Land use dynamics in Latvia, 1000 ha

Year	Total area	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
1990	6 457.30	3 168.56	1 842.24	755.01	238.82	448.35	4.32
1991	6 457.30	3 174.97	1 837.27	752.97	239.41	448.35	4.32
1992	6 457.30	3 179.04	1 833.98	751.61	240.01	448.35	4.32
1993	6 457.30	3 185.57	1 828.93	749.53	240.60	448.35	4.32
1994	6 457.30	3 192.65	1 823.50	747.29	241.19	448.35	4.32
1995	6 457.30	3 200.04	1 817.85	744.96	241.78	448.35	4.32
1996	6 457.30	3 210.13	1 810.36	741.89	242.26	448.35	4.32
1997	6 457.30	3 220.12	1 802.95	738.84	242.73	448.35	4.32

Year	Total area	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
1998	6 457.30	3 227.86	1 797.12	736.44	243.20	448.35	4.32
1999	6 457.30	3 238.67	1 789.13	733.16	243.67	448.35	4.32
2000	6 457.30	3 247.70	1 782.39	730.39	244.15	448.35	4.32
2001	6 457.30	3 259.79	1 773.20	726.61	245.04	448.35	4.32
2002	6 457.30	3 268.30	1 766.53	723.87	245.92	448.35	4.32
2003	6 457.30	3 277.47	1 759.41	720.94	246.81	448.35	4.32
2004	6 457.30	3 288.49	1 750.97	717.47	247.70	448.35	4.32
2005	6 457.30	3 299.88	1 742.26	713.90	248.59	448.35	4.32
2006	6 457.30	3 311.64	1 733.30	710.21	249.48	448.35	4.32
2007	6 457.30	3 323.77	1 724.07	706.43	250.36	448.35	4.32
2008	6 457.30	3 336.27	1 714.58	702.53	251.25	448.35	4.32
2009	6 457.30	3 349.41	1 704.63	698.45	252.15	448.35	4.32
2010	6 457.30	3 348.26	1 704.78	698.49	253.10	448.35	4.32
2011	6 457.30	3 347.17	1 704.87	698.52	254.07	448.35	4.32
2012	6 457.30	3 346.18	1 695.32	708.07	255.06	448.35	4.32

The most of the changes occur due to the conversion of forest land to settlements or cropland, conversion of cropland to grassland and grassland to forest land. Only net changes are accounted except for deforestation and afforestation.

Data on increment of aboveground living biomass are provided by the NFI. Country specific expansion factors and wood densities are used in calculation of carbon stock changes in living and dead woody biomass.

Key carbon pools[4] and sources in LULUCF sector

Soils of Latvia have a wide range of distinct specific traits. They are mainly determined by parent material, its peculiar mineralogical and chemical composition, and presence of carbonates. Climate, vegetation cover, textural and chemical composition as well as origin of parent material, character of its bedding, bulk density and water-air regime are the factors determining soil genesis, soil properties and fertility.

Latvia is located in a humid and moderate climatic region with rainfall exceeding evaporation (soil moisture coefficient > 1) resulting in a percolating moisture regime in the soil. The mean annual temperature is 6.6 ^{0}C in Southern Latvia (town Liepaja) and 4.2 ^{0}C in Northern Latvia (town Aluksne). The mean annual rainfall ranges from 550 to 600 mm in the lowlands and from 700 to 800 mm in the uplands. The climate of Latvia promotes leaching of automorphic soils, podzol-formation; water accumulation on less permeable soil layers results in soil gleying, bog formation and development of Semihydromorphic and Hydromorphic soils.

According to its hydrothermic properties, Latvian soils are divided into three classes: Automorphic, Semihydromorphic and Hydromorphic. Automorphic soils develop in well drained

[4] http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=271

sites with good water retention, and are usually associated with a deep groundwater table. Due to good decomposition of organic matter under aerobic conditions, these soils are not high in humus.

In Latvia, agricultural lands are situated on soils of relatively high diversity, formed on different, mainly unconsolidated Quaternary deposits.

Soil fertility depends on soil parent material, and the most fertile soils are related to increase of content of clay and silt particles, where according to World reference base for soil resources (WRB, 2014) widely distributed are Luvisols, Stagnosols and Retisols. The most fertile soils – Luvisols are distributed in Zemgale plain.

Furthermore, groundwater table and soil moisture regime determines Gleysols distribution, however in organic matter and peat accumulation areas Histosols are distributed.

The most productive soils of Latvia have been formed on clayey parent materials enriched with carbonates (2-20 %), such as moraines, glaciolacustrine deposits, alluvial and deluvial drifts. Many soils essentially contain no carbonates, being leached out from the upper soil.

Major soil improvement methods in Latvia are drainage and reclamation, liming, build-up of humus, fertilizer use, subsoiling, levelling and clearing the fields of boulders, soil erosion control.

The most significant key category in LULUCF sector is CO_2 in **Forest land remaining forest** contributing 45 % of level of the emissions and 47% to the trend in 2012. Another key source category where CO_2 emissions are increasing since 1990 is **Land converted to settlements. All kinds of deforestation are between the most important sources of emissions having tendency to grow due to the development of road network and industrial infrastructure. Deforestation to grassland and cropland are becoming more common. There are indications that this type of land use changes will considerably increase and produce more CO_2 and N_2O emissions in the near future.**

The most challenging task in cropland and grassland management is to secure continuous accumulation of carbon in soil by application of measures targeted to improvement of soil fertility, including cropping systems considering regular application of green manure, use of organic fertilizers, drainage and tillage methods transporting carbon to deeper soil layers. There are various ways in which different land management practices has been applied already in Latvia, in order to increase soil organic matter content, such as increase of the biomass yields and crop rotation systems. The main way to achieve an increase of organic matter in the soil up to now is through reduced tillage and returning of dead herbaceous biomass to the soil.

In 2010, after the CSB data applied land management practices (tillage methods) were as follows: 88% of those of the cultivated arable land were transferred to the conventional tillage, 10.3% were used minimum tillage and 1.7% of those of the cultivated arable land was used for direct sowing or zero processing.

Since 2008 Latvian University of Agriculture has been working of long-term study *"Effects of Soil Tillage Minimization and Crop Rotation on the Weediness of Crops"*[5]. This study aims to determine the minimum tillage volumes on soil physical properties and chemical composition changes in long-term pest development and spread of crop size and quality compared to traditional production technology.

[5]http://llufb.llu.lv/conference/Latvia_Agricult_Science_Successful_Farming/Latvia_Agricult_Science_Successful_Farming-32-35.pdf

Land Sector Profile

In the light of climate change mitigation targets, it is important to preserve areas that have high carbon sequestration capacity: forests, peatlands and grasslands, as well as to promote carbon sequestration through sustainable management of forest and peatlands, afforestation, improvement of cropland and grassland management practices to secure sequestration of carbon in soil as well as establishment of perennial crops having considerable growth potential.

Forestry is of great importance for Latvia's economy and the environment, and therefore the forest policies have the major effect on the whole development of the LULUCF sector. Private forest owners own a bit more than 50% of Latvia's forests; the rest is managed mainly by the Joint stock company "Latvia's State Forests". Structure of ownership of the private forests is changing rapidly and consolidation of properties takes place. Taking into account **the age structure of Latvia's forests** and the structure of forest resources (currently nearly a third of forests meet the threshold values of regenerative felling and **share of mature forests is rapidly increasing**), the regeneration of our forests with decreasing of the annual increment (following with reduction of CO_2 removals in living biomass and other carbon pools in forest lands in short term) is the only strategically sustainable approach in forest management. Most of overgrown forests are of those owned privately by private persons or they are economically inaccessible – felling and regeneration costs are higher than potential income. These forests require investments for reconstruction as well as for development of the forest management infrastructure (roads and drainage systems). **The forest infrastructure** (road network and drainage systems), especially **in private forests, is poorly maintained** and needs investments for reconstruction and expansion of the networks. For instance, density of forest road network in Latvia is 1.1 km per 100 ha, in private forests – only 0.3 km. In Sweden and Finland the density of forest road network is 3 km per 100 ha. Drainage systems in private forests in Latvia have not been reconstructed for at least 25 years and there are still 572 kha of forest on wet mineral (302 kha) and organic (270 kha) soil, where **drainage can considerably contribute to further increase of CO_2 removals** in living biomass and other carbon pools. According to the NFI data there is a considerable potential to increase forest harvesting stock in future, especially in deciduous tree stands and over-mature forests, to increase the rate of regeneration of forests and to avoid distribution of diseases and pests in weakened diseasing forest stands. According to different projections, the bioenergy sector, **especially export markets, might contribute to utilization of the forest resources,** which were not economically accessible up to now. By the year 2015 it is expected that more wood, including a part of pulpwood assortment will be used in energy sector because **the objectives of renewable energy sources in the EU have to be reached.** The process has already started; production of wood pellets is nearly doubled within 5 years, reaching 1 million tonnes annually. **Local bioenergy market is also developing,** securing outputs for low grade biomass like harvesting residues and below ground biomass. All forest land is considered as managed in Latvia. **About half of forests in Latvia are certified by the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) systems.**

The increased felling rate during the last decade, which is also projection for the future decades, will result in decreased forest stock. At the same time **the area of overgrown forests will also increase,** contributing to continuously high mortality rate and CO_2 emissions from dead wood in future. Forest growing stock is the most important factor of keeping LULUCF sector GHG emissions' and removals' balance positive. The decrease of felling rates would result in increasing of carbon stock in living biomass for the period of 2014-2020. However, in long term this solution would result in increased GHG emissions due to mortality, lost economic potential of forests and, possibly, in broader distribution of certain forest pests and diseases in mature stands resulting in expanding of natural disturbances. Nearly one third of forests in Latvia has exceeded economic maturity age and meets the threshold values of regenerative felling criteria being at the same time more vulnerable to storms and diseases. Ability of these forests to accumulate carbon is lower than that of young and pre-mature forests. The development of forestry provides additional employment opportunities, increases budget incomes and contributes to implementation of the energy policy targets of the European Commission. Maintenance or even increase of felling rates will result in decrease of forest carbon stock but at the same time, the Harvested Wood Products (HWP) pool will not decrease and users of forest biofuel will receive a predictable amount of forest biomass. Using renewable energy sources like wood instead of natural gas and other fossil fuels is extremely important for Latvia in a long run. Forest management should also compensate long term decrease of carbon stock in protected forests maintained to preserve biological diversity. In the way of preparation of protection rules in forest land and grassland, it is necessary to consider the socio-economic impacts occurring with implementation of the protection regime in order to harmonize different targets and to secure economic development of rural areas. Due to insufficient use of support to afforestation of the abandoned land and improvement of stand quality in naturally afforested areas, the value of forests in afforested lands in Latvia is much lower as compared to forest land remaining forest and the carbon accumulation potential of new forest stands will not be fully utilized. For instance, there are lots of non-productive grey alder and aspen stands. It is more beneficial from the climate change mitigation prospective to use these areas for growing economically and ecologically more valuable species, like spruce and birch, or even fast growing tree species, like hybrids of poplar, aspen or larch. In order to provide efficient forest management, the development and maintenance of infrastructure (road access and water regime) is also important, especially in private forests. In order to prevent forest fires and expansion of forest pests and diseases, better preventive systems and monitoring of the forest fire, pests and diseases should be implemented.

Agriculture as land use plays an important role both in the economy and in the preservation of the traditional lifestyle in Latvia, since agriculture contributes to the development as an economic activity, as a livelihood, and as a provider of environmental services, making the sector a unique instrument for development. In 2014 in Latvia, 32% of the entire population lived in rural areas.

Sector is diverse and influences such sensitive areas as food security, rural employment, social inclusion and sustainable development in rural areas. Share of agriculture and forestry in total GDP is 4.9 % (CSB, 2014). As compared with the EU average, Latvian agriculture is partially extensive and still in a developing phase – low livestock density, fertiliser usage and relatively high GHG emissions per produced unit.

In Latvia cultivation of organic soils (cropland and grassland) formed the substantial part of total emissions. Assuming that share of organic soils under cultivated area (particularly in cropland and grassland) in Latvia is 5.18% of the total area, which is considerable quantity of emissions with a very limited abatement potential. This proportion of cultivated organic soils and also peatland makes Latvia different from Central and Southern Europe. Emissions from agricultural soil contribute the major share of the total emissions from the agriculture sector – 63%, emissions from enteric fermentation - 28%, emissions from manure management – 9%.

The area of cropland in Latvia has decreased by 8% since 1990 due to reduction of livestock production. In recent years situation has changed due to overall increase of economic activity as well as support provided by the Rural Development Programme and national financial instruments. From 1990 to 2004, an overall decline characterised agriculture in Latvia. Arable lands were abandoned due to the reduced demand for food products, which was caused by the availability of cheap imported goods as the result of opened markets and unequal distribution of agriculture subsidies in Europe. As from 2004, the cropland area used for crop production has been increasing again due to increased investments and subsidies from the European Commission to agriculture in Latvia and expansion of export opportunities. Particular feature of agricultural land use in Latvia is the presence of previously used but now still abandoned fertile arable land. The characteristics of these lands still do not meet thresholds for forest land; therefore, they are reported under cropland or grassland, depending from management activities. Two the most frequent scenarios are occurring in this case – either afforestation (natural or human induced) or land is brought back to normal agricultural production. **National target set in the National Development Plan 2014-2020 foresees that by 2020 share of managed farmland has to be 95 % from total land area that can be used for agricultural purposes**. Latvia has made GHG projections until 2030 and a significant increase for agriculture is projected to achieve the EU average agricultural output. **As a result of the above mentioned, agriculture in Latvia has a double growth potential – horizontal (abandoned fertile agricultural land) and vertical (extensive management model with potential for sustainable intensification).** The share of the grassland is 11% of the overall area of Latvia, ranking grasslands as the third largest land-use category after forest land and cropland. By 2012, the area of grassland decreased by 6% as compared to 1990 due to natural afforestation of farmlands not used any more in fodder production.

Net CO_2 eq. emissions from cropland decreased from 1990 to 2012 by 17 % due to reduction of area of cropland, as well as reduced impact of deforestation to cropland taking place in early nineties; however, the NFI data and production statistics highlights potential increase of the GHG emissions in cropland in future due to more favourable conditions for farming (positive climate change impacts and continuously increasing support to farmers).

GHG emissions from cropland are related to emissions from organic soils (5.2% of the total area of cropland and grassland), carbon stock changes in living biomass and land use change to cropland. The most important source of emissions in cropland is organic soil; the role of land use changes and emissions from other pools is reducing, but there are indications (recent increase of production, predictable and more favourable subsidies in agriculture) demonstrating that the GHG emissions due to land use changes will increase again in the near future. However, the most of changes will take place in the extensively managed cropland, where intensification of management system (e.g. increased livestock numbers and use of fertilizers) might actually lead to increase of carbon stock in soil if proper management systems are applied. Cropland area has decreased due to the land use change from cropland to grassland which results in increased CO_2 removals in soil. Opposite process causing N_2O and CO_2 emissions took place due to conversion of forest land to cropland; however, conversion of forest land occurs to lesser extent than conversion of cropland. Increasing rate of conversion of grassland to cropland will raise CO_2 and N_2O emissions from mineral soil. The conversion of organic soil is not realistic scenario due to economic barriers.

Reduction of the GHG emissions from cropland can be reached by crop diversification, including more intensive use of green manure. On other side, any additional crop in rotation, especially green manure, will require more land to maintain the production; therefore, the positive effect on one farm might turn into a negative effect at the landscape level.

Agricultural soils in Latvia suffer from lack of calcium and acidification quite often. Quick-acting dolomite or other liming materials are used to eliminate calcium deficiency. Liming is important measure to maintain productivity of soil and to avoid leaching of nutrients from soil.

Research and dissemination activities are necessary to advise farmers on environmentally friendly and sustainable management of cropland to increase their value and to contribute to accumulation of carbon in soil. Transfer of knowledge to farmers requires an efficient advisory system. There is synergy between the measures really reducing GHG emissions and increasing productivity of cropland. High yields in productive lands will also reduce pressure on grassland and forest land, avoiding land use changes and contributing thus to biodiversity and environmental targets.

Agro-forestry systems and short rotation woody crops (buffer zones and short rotation plantations) have one of the largest potential to reduce GHG emissions in cropland, contributing also to the implementation to the energy policy targets and reduction of nutrients leaching. However, these measures were not popular up to now due to lack of practical experience, financial support and research based knowledge. In the future, the role of the short rotation woody crops and agro-forestry systems, as alternative to extensive cropping systems, may increase, however demand for agricultural land is growing, agricultural production becomes intense and competition between woody crops and traditional agricultural production on extensively used or abandoned agricultural land becomes stronger.

Grassland is a net source of the GHG emissions due to CO_2 emissions from organic soils; however, wildfires in grassland might be considerable source of the GHG emissions. There is tendency of decrease of the grassland area due to afforestation and due to conversion of abandoned farmlands back to crop production. In natural conditions grasslands are glades in forest and alluvial lands. Artificial activities introduced new type of grasslands – pastures, and, recently – so called perennial grasslands, where grass and bushes are regularly cut but not used as a crop. The reduction of the grassland area takes place mainly due to afforestation of pastures and perennial grasslands and by conversion of the latest category to cropland. There are no measures directly contributing to increase of carbon stock in grassland or to reduction of GHG emissions from grassland; however, the emissions will reduce due to reduction of the grassland area on organic soil. The forest fire prevention system is not evaluated as numeric value of reduction of the GHG emissions due to lack of research data, but this activity will have the largest potential to reduce GHG emissions, both in forest land and grassland.

Wetlands cover more or less 10 % of the territory of Latvia. Area of wetlands (including swamps, peatland and inland water bodies) did not change significantly since 1990. **Potential to reduce GHG emissions can be found also in peatlands**. The most of the emissions from peatland are related to production of peat products **for horticulture. Peat for energy** is produced in negligible amount, nevertheless, the production potential is huge due to the fact that peat, just like timber, consists of more and less valuable fractions of whom less valuable fraction (peat fuel) is now left in a field. Abandoned peatlands (according to different sources at least 20 000 ha) are a considerable source of CO_2, CH_4 and N_2O emissions. In order to reduce GHG emissions from peat extraction sites, it is important to secure extraction of all fractions of peat, including the material suitable for fuel production, **and restoration of the degraded land** to forest land or other land use category if the afforestation is not possible. Restoring the water regime of those abandoned peat extraction sites **would allow restoration of natural ecosystem in former bogs in long term**; however, this measure is not always possible or reasonable. Drained areas should be prioritised to identify the needs for and sequence of their rehabilitation and restoration.

Also, **further drainage of natural peatlands, having considerable ecological value, should be avoided** to contribute to implementation of the national nature conservation targets. It should also be considered that rewetted peatlands are also source of emissions; therefore the restoration strategy should be comprehensive and consider all consequences of the proposed measures.

LULUCF sector is a source of CO_2 emissions since 2010, because accumulation of carbon in living biomass pool in forest land cannot any more compensate GHG emissions from organic soil, particularly, those in cropland and grassland. **The projections of the GHG emission cannot predict potential impact of relevant policies in other European countries, like energy policy,** which can have a dramatic impact on CO_2 emissions due to forest and cropland management and land use changes due to increase of harvests and establishment of energy crops. Similarly, potential impact from application of new calculation methods is not fully evaluated and might affect results of the projections, especially soils related emissions.

Past emissions and removals

The methods of calculation of emissions in LULUCF sector are significantly changed in 2015 submission due to transition to the new IPCC guidelines (Eggleston *et al.*, 2006; Hiraishi *et al.*, 2013) and application of more updated emission factors. For instance, calculation of the GHG emissions due to peat production for horticulture, according to the new guidelines, increased the CO_2 emissions by approximately 900 kilotons CO_2 in 2012

Significant changes in 2015 GHG inventory are implemented also due to change of data source for harvesting shifting from State Forest Service provided information to NFI data. Since in 2013 NFI second cycle has been completed and in 2015 data processed for NIR reporting and **whole data series up to 1990 are recalculated**. Now it allows for harmonised reporting for both increment and harvesting from the same data source.

According to current status of recalculations net emissions of aggregated GHGs (CO_2, CH_4 and N_2O) in LULUCF sector in 2012 were -416,84 kilotons of CO_2 equivalents (Figure 3). The most of the emissions and removals are associated with the carbon stock changes, mainly in forest living biomass. Aggregated net emissions of the GHGs increased considerably in 2012 as compared to 1990. The increase is associated with growth of the harvesting rate and ageing of forests, resulting in increase of the natural mortality and reduction of the increment of trees. Settlements and cropland is the source of the GHG emissions mainly due to land use changes – conversion of forest land - and emissions from organic soils. **The largest source of CO_2 emissions in cropland and grassland are organic soils.**

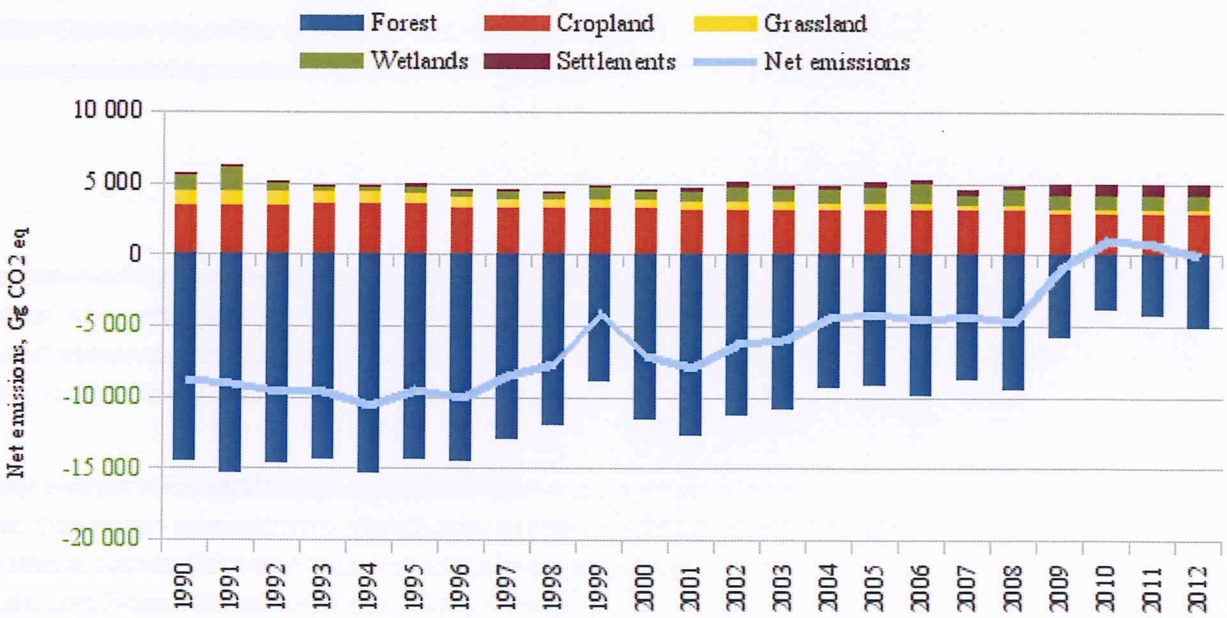

Figure 3: Net emissions in LULUCF sector

Forest land

The aggregated net emissions from forest lands in 2012 in Latvia were -3138 kilotons of CO_2 eq., excluding HWP (-2005 kilotons of CO_2). The most of the emissions are associated with organic soils and commercial felling. Both, the harvesting related emissions and removals in living biomass increased during the reporting period (Figure 4).

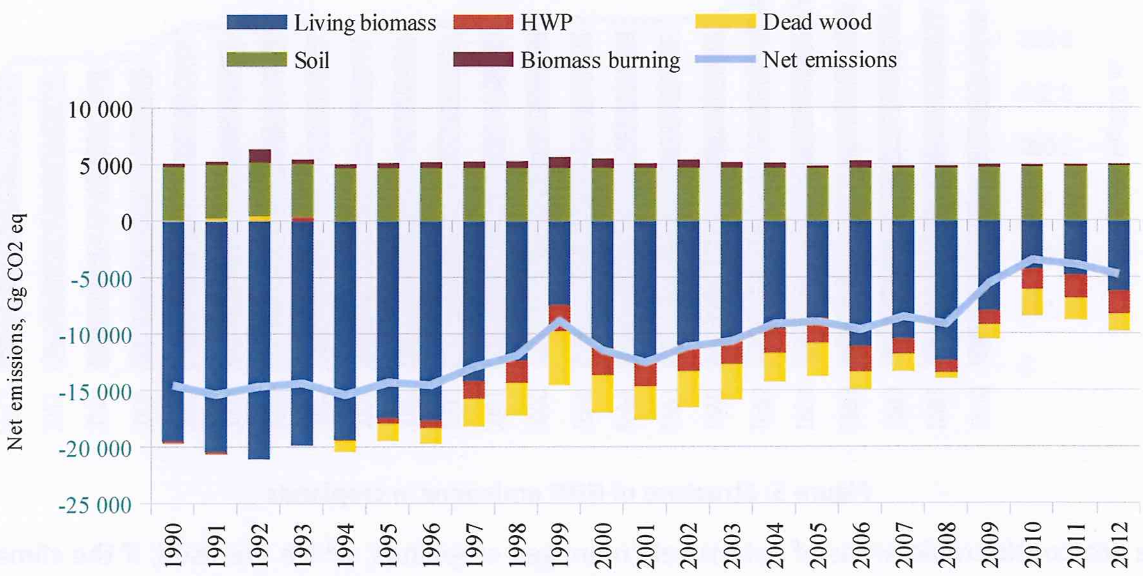

Figure 4: Structure of GHG emissions in forest lands

Calculations of carbon stock changes and GHG emissions in forest lands differs from the official submission 1990-2012 due to implementation of IPCC 2006 guidelines and their 2013 amendment for wetlands. Calculations are based on activity data provided by the NFI (area, living biomass and dead wood) and Level I forest monitoring data (soil). National statistics (State Forest Service) are used to estimate forest fires and commercial felling related emissions and removals. The calculation of GHG emissions and CO_2 removals in historical forest lands is based mainly on research report "Elaboration of the model for calculation of the CO_2 removals and GHG emissions due to forest management" (Lazdiņš *et al.*, 2012a) and factors and coefficients elaborated within the scope of the research program on impact of forest management on GHG emissions and CO_2 removals (Lazdiņš *et al.*, 2013).

Cropland

Under the cropland category, emissions from organic soils and emissions due to losses of organic carbon from soils due to conversion of mineral soil to cropland are accounted. Net aggregated emissions from cropland were 2846 kilotons of CO_2 eq. in 2012 (Figure 5).

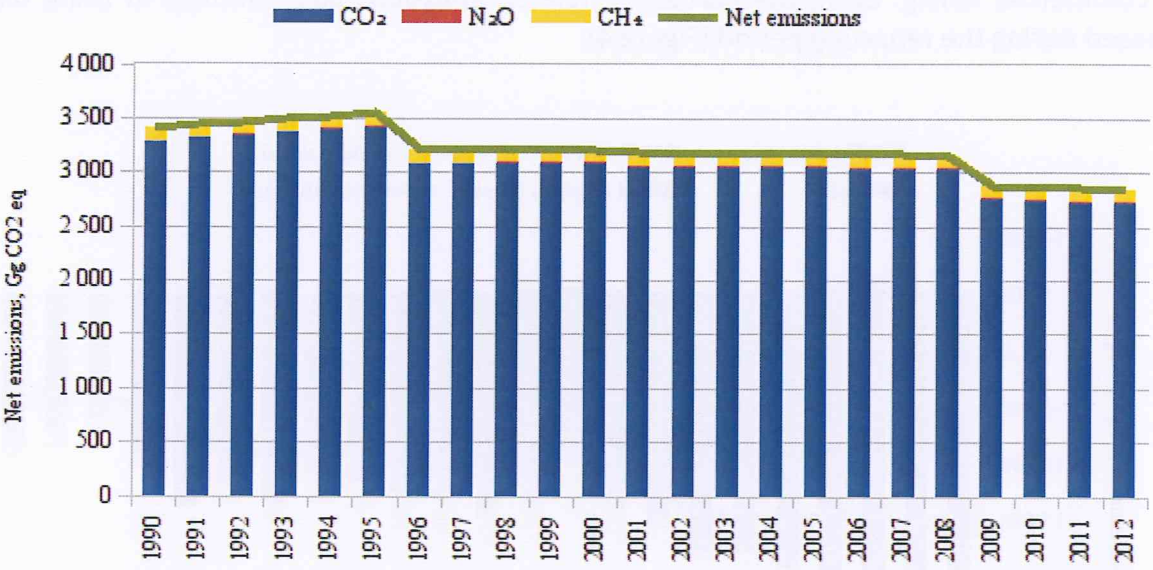

Figure 5: Structure of GHG emissions in croplands

There are considerable areas of extensively managed croplands, which are used, if the climatic or economic conditions are favourable, but the most of the time they are set aside or extensively used in fodder production. It is complicated to identify, when the cropland is really converted to grassland or if it will be used again for crop production. The decision support tree was elaborated in 2013 to simplify identification of land use changes in farmlands and due to conversion of cropland or grassland to forest land in the NFI data (Table 2). The identification of transition in this case takes 10 years. After implementations of this approach are of cropland considerably increased and land use changes (cropland to grassland and vice versa) considerably decreased, however, there is tendency of increase of the grassland area due to conversion of cropland to grassland, which is partly compensated by afforestation.

Table 2: Decision support tool for conversion of grassland, cropland and forest land
(Lazdiņš & Čugunovs, 2013)

First NFI 2004-2008	Second NFI 2005-2013	Third NFI 2014-2019	Fifth NFI 2020-2024
Initial land use – *grassland*	Whole plot or sector is ploughed – *no land use change marked*	Whole plot or sector is ploughed – *ploughed area is marked as cropland since second NFI*	Whole plot or sector is ploughed – *the area remains cropland*
			No signs of ploughing – *the area remains cropland*
		No signs of ploughing – *the area remains grassland*	Whole plot or sector is ploughed – *the area remains grassland*
			No signs of ploughing – *the area remains grassland*
	No signs of ploughing – *the area remains grassland*	Whole plot or sector is ploughed – *the area remains grassland*	Whole plot or sector is ploughed – *ploughed area is marked as cropland since third NFI*

First NFI 2004-2008	Second NFI 2005-2013	Third NFI 2014-2019	Fifth NFI 2020-2024
			No signs of ploughing – *the area remains grassland*
		No signs of ploughing – *the area remains grassland*	Whole plot or sector is ploughed – *the area remains grassland*
			No signs of ploughing – *the area remains grassland*

Grassland

Grasslands consist of lands used as pastures and meadows, as well as glades and bush-land that do not fit into the forest definition, including vegetated areas on non-forest lands complying to forest definition where land use type can be easily switched back to grassland without legal requirement of transformation of the land use, but except for grassland used in forage production and extensively managed cropland.

The grassland remaining grassland in Latvia is a key source of CO_2 emissions from organic soil. Land converted to grassland, however, is net source of removals of CO_2 in soil. Total area of grassland in Latvia in 2012 was 708 kha, including 541 kha of grasslands remaining grasslands and 167 kha of cropland converted to grassland (Lazdiņš & Zariņš, 2010; Lazdiņš, 2011; Lazdiņš & Čugunovs, 2013). The net emissions from grasslands in Latvia in 2012 were 265 kilotons CO_2 eq. Pikes of emissions associated with burning of grass (for instance, in 2006) are because of considerably larger area of wildfires. The CO_2 removals are accounted in living and dead biomass in forest lands not fulfilling criteria of forest definition.

The area of organic soils is considered 5.18% of total area of grassland according to study results (L.U. Consulting, 2010). These figures are based on municipality level summaries of soil mapping data and characterize situation before 1990 (data utilized in calculation were obtained from the 60s to early 80s). Dynamics of area of organic soils in grasslands are shown in Figure 6. Increase of the area of organic soils is associated with conversion of cropland to grassland in the last two decades.

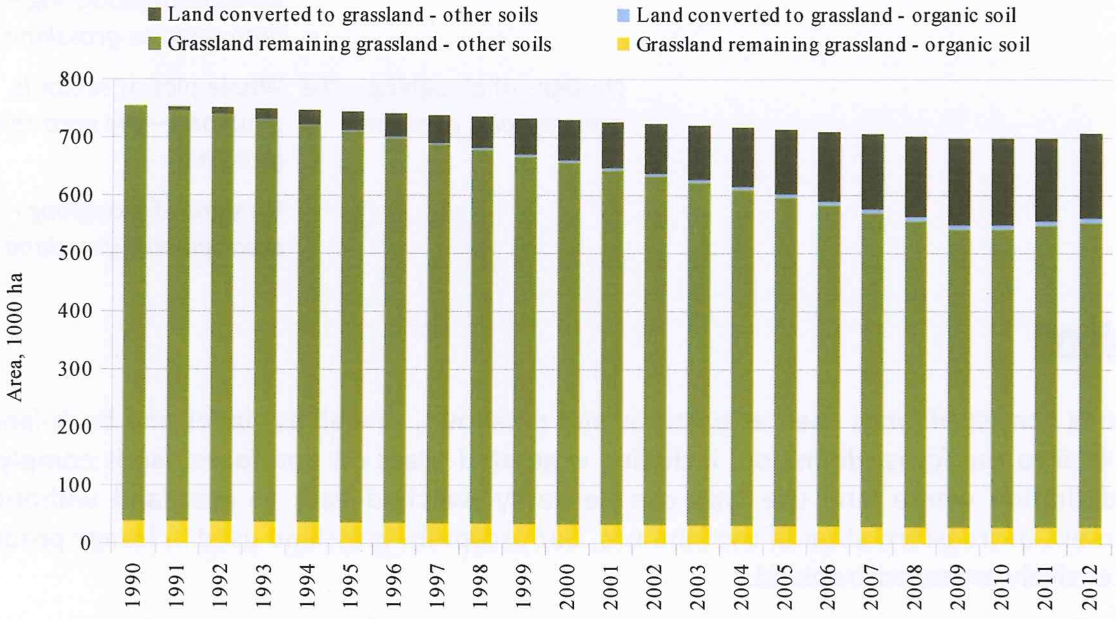

Figure 6: Area of organic and mineral soils in grasslands

In grasslands, the most significant source of emissions is organic soils. Due to emissions from soil of grassland remaining grassland is considerable source of emissions (Figure 7).

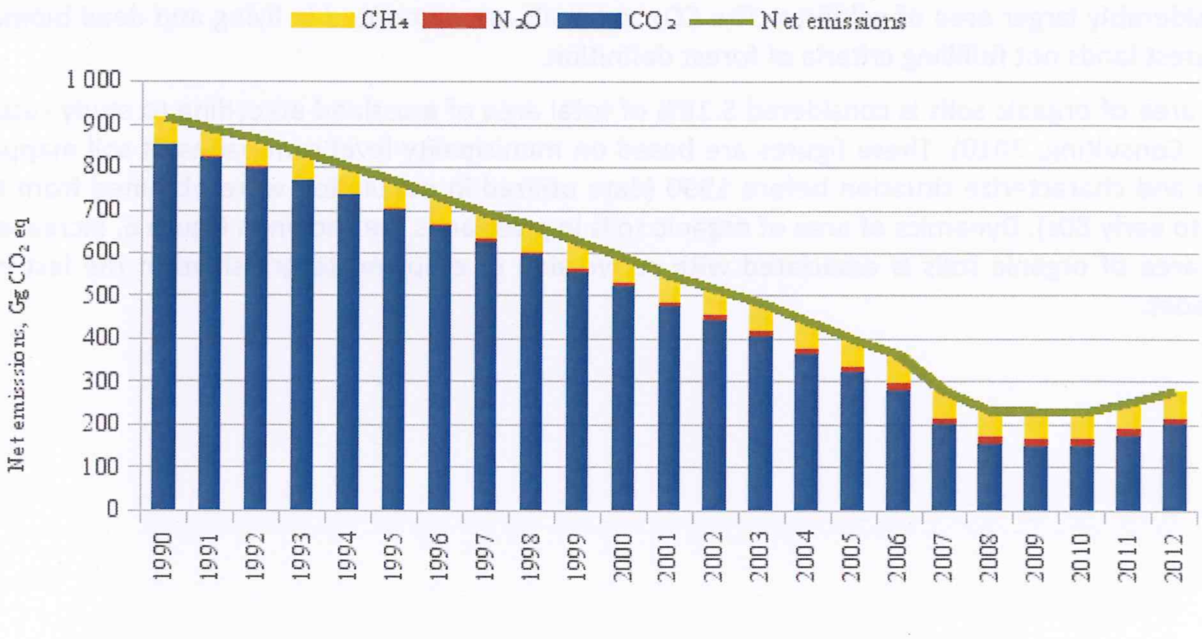

Figure 7: Net emissions from grassland

Harvested Wood Products

Harvested wood products are a key source of CO_2 removals. Increase of removals in the harvested wood products during the last decade is associates with increase of harvesting rate and implementation of more advanced timber processing technologies.

Net emissions of production of the harvested wood products are calculated on the base of the methodology elaborated in 2011 by S. Rüter for estimation of the forest management reference level for the 2013-2020 reporting period of the Kyoto protocol (Rüter, 2011).

The net emissions in harvested wood category in 2012 were -2005 kilotons CO_2. The net emissions during the reporting period are shown in Figure 8. Harvested wood products are very important carbon pool, which has to be considered in long term forest management planning. In long term removals in harvested wood products will decrease according to projections of rather constant felling stock; however, new technologies resulting in more efficient utilization of biomass might increase utilization of low grade timber in plate wood production.

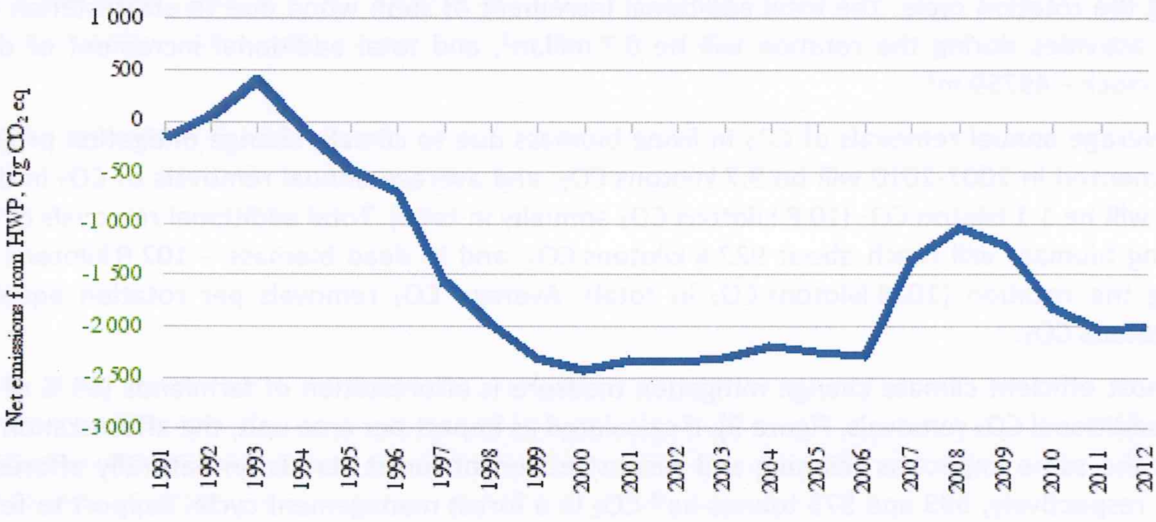

Figure 8: Net emissions from harvested wood products

Results of implementation of the Rural Development Programme 2007-2013

The initial evaluation of implementation of the Rural Development Programme 2007-2013 was done at the end of 2010 by the Latvian State Institute of Agrarian Economics (Lazdiņš, 2010). According to the report, climate change mitigation measures were implemented in 14490 ha of forest in 160 municipalities of Latvia. The average additional annual increment of stem wood due to afforestation of farmlands and other activities (projects implemented until 2010) will be about 7288 m^3, and the average additional annual increment of the dead wood will be about 588 m^3 during the rotation cycle. The total additional increment of stem wood due to afforestation and other activities during the rotation will be 0.7 mill.m^3, and total additional increment of dead wood stock – 49759 m^3.

The average annual removals of CO_2 in living biomass due to climate change mitigation projects implemented in 2007-2010 will be 9.7 kilotons CO_2, and average annual removals of CO_2 in dead wood will be 1.1 kiloton CO_2 (10.8 kilotons CO_2 annually in total). Total additional removals of CO_2 in living biomass will reach about 922.6 kilotons CO_2, and in dead biomass – 102.0 kilotons CO_2 during the rotation (1024 kilotons CO_2 in total). Average CO_2 removals per rotation equal to 0.5 kilotons CO_2.

The most efficient climate change mitigation measure is afforestation of farmlands (85 % of the total additional CO_2 removals, Figure 9). If calculated as impact per area unit, the afforestation has about the same impact as thinning and reconstruction of forest stands on naturally afforested lands, respectively, 583 and 573 tonnes ha^{-1} CO_2 in a forest management cycle. Support to forest regeneration has relatively smaller impact on additional CO_2 removals (56 tonnes ha^{-1} CO_2). The evaluation of the preliminary results of impact of the Rural Development Programme 2007-2013 demonstrated dominating impact of the forestry related measures, especially thinning and reconstruction of the naturally afforested lands.

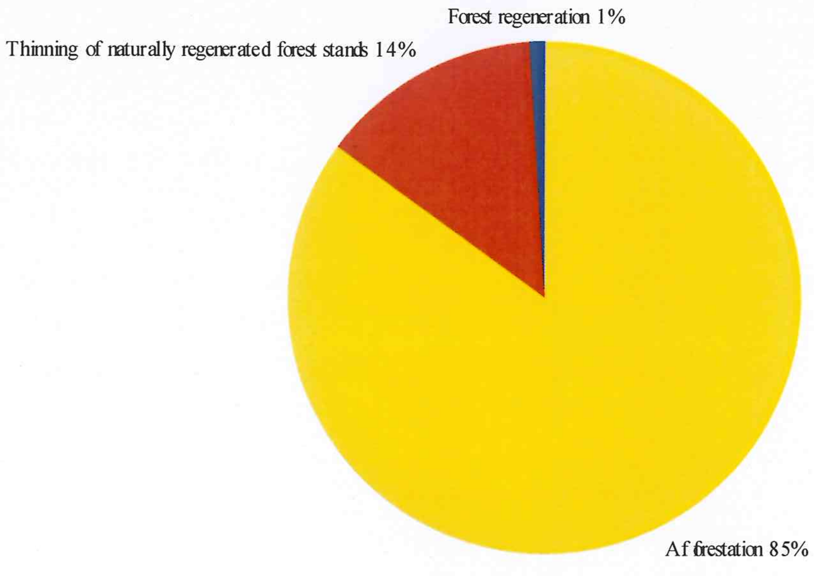

Figure 9: Summary of impact of different measures on reduction of the GHG emissions in 2007-2013

Projections for 2013-2030

This chapter provides projections for GHG emissions and removals for the period 2013-2030. Taking into account the best available data, the future projections of the GHG emissions and CO_2 removals in forest land, cropland and grassland are provided. Two scenarios of the emissions' projections are provided. "WEM" scenario represents projections with existing measures and "WAM" shows projections with additional measures, which are proposed in the Rural Development Programme 2014-2020.

Projections of the future GHG emissions and CO_2 removals are compiled using National Inventory Report (NIR) 1990-2013 draft report (May 20015) and documents related to elaboration of the Rural Development Programme 2014-2020. According to both scenarios, felling rates will remain similar as of recent years (2009-2013) considering 10% increase of felling stock until 2020 according to assumptions used by the JRC in calculation of the Forest Management Reference Level (FMRL) for Latvia; and forest land will remain a net sink of CO_2 removals during the period 2015-2030. The net removal on forest land is expected to be in average -1506 kilotons CO_2 eq. annually during 2015-2030 in case of the "WEM" scenario. According to "WAM" scenario the average net CO_2 removals in forest land will increase to 1599 kilotons CO_2 eq. annually during 2015-2030. In both scenarios it is complicated to predict impact of the international energy policy because considerable share of forest lands already reached maturity age and only economic barriers hamper increase of the annual felling stock. Similarly, in croplands the demand of biomass for biogas production and other energy applications can increase crop production in extensively used cropland; however, the impact on CO_2 emissions in croplands depends on the land management system applied to the energy crops. Perennial energy crops and agro-forestry systems are another type of production, which can rapidly expand in case of favourable economic conditions. Depending on the extent, perennial energy crops can turn cropland into the net sink of CO_2 removals or considerably reduce the net GHG emissions.

Cropland area is expected to increase in comparison to the situation in 2012. GHG emissions from cropland in 2013-2030 will decrease according to the projections due to reduction of deforestation activities, but cropland will still be a source of the GHG emissions due to conversion of grassland to cropland. Grasslands are likely to continue to decline in the near future, mainly due to afforestation of less valuable lands and conversion to cropland of more fertile fields. However, grassland is expected to be a source of CO_2 emissions in 2013-2030 due to considerable share of organic soils.

The most important difference between the measures in cropland and forest land, except investments in the drainage systems, is the economic sustainability of the measures. If the implementation of the forestry measures requires only few input in the rotation period (afforestation, thinning, forest regeneration); then the measures in cropland requires annual input to maintain these management systems. Therefore the risk of successful implementation and long term immobilization of carbon is higher in cropland. Exception is reconstruction of drainage systems, which secures long term increase of productivity of the affected lands. Farmers might learn also benefits from crop rotations, like fewer damages from drought and better use of nutrients and this measure might become self-sufficient in future.

The total impact of the proposed measures in comparison with the total emissions in the LULUCF sector will be comparably small due to considerable share of emissions from organic soils, which cannot be eliminated.

Projections of emissions with measures

There are several climate change mitigation measures, which were implemented during the previous RDP, including afforestation, pre-commercial thinning and reconstruction of heavily damaged or diseased forest stands. All of these measures have long lasting impact. However, the short term impact on GHG emissions is relatively small, especially considering limited scale of implementation of these measures in comparison to the economic and other drivers, which are affecting the increase of the GHG emissions in LULUCF sector, especially due to conversion of forest land to cropland and settlements and grassland to cropland and increase of mortality in forest land due to ageing of forests.

The net annual GHG emissions in LULUCF sector in 2020 will increase to 5138 kilotons CO_2 eq. and in 2030 – they will increase to 7361 kilotons CO_2 eq.

The projection with the implemented measures considers increase of the felling stock by 10% during 2015-2020 in compare to 2009-2013 in forest land, increasing deforestation to build new settlements (mostly roads), and conversion of grasslands (abandoned farmlands not used in production for at least 10 years) to cropland. According to the projection with already implemented measures, the net CO_2 removals in forest land will reduce in 2020 by 67% and in 2030 – by 95% in comparison to 2012. GHG emissions in cropland will increase in 2020 by 12 % and in 2030 – by 11 % in comparison to 2012.

Projections of emissions with additional measures

Implementation of the measures will reduce the net CO_2 emissions by 3131 kilotons CO_2 eq. in 2013-2030 (in average 196 kilotons CO_2 eq. annually starting from 2015). In cropland implementation of the measures will reduce the net CO_2 emissions by 1643 kilotons CO_2 eq. in 2013-2030; in forest land – by 1488 kilotons CO_2 eq. in 2013-2030. The impact of the measures in forest land as well as due to drainage in cropland will continue after 2030, showing the most of impact in following years. The total net emissions from LULUCF sector will reduce by 2.5% (to 7134 kilotons CO_2) in 2030 due to implementation of the additional measures (Figure 10). Situation in forest sector is separately shown in Figure 11. The most visible change is reduction of net removals of CO_2 in dead biomass due to emissions caused by decomposition of harvesting residues and dead trees.

The impact of the measures in cropland is reported using Tier 1 method of the IPCC guidelines (Eggleston *et al.*, 2006). Application of tier 2 methods, which will be elaborated for the key source categories, including mineral and organic soils, will correct the obtained results. Additional uncertainty in the cropland projections is introduced by the initial status of carbon stock in soil in lands, where the measures will be implemented; the real figures might differ from average values applied in the calculation.

More detailed description of the measures is provided in following chapters (Measures in cropland and Measures in forest land).

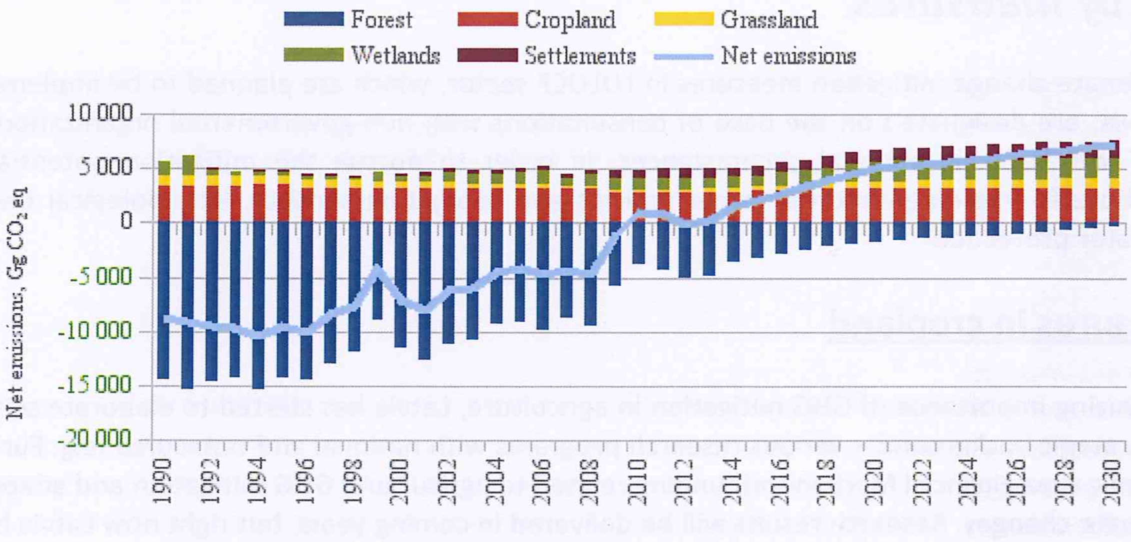

Figure 10: Net GHG emissions in LULUCF sector in WAM scenario.

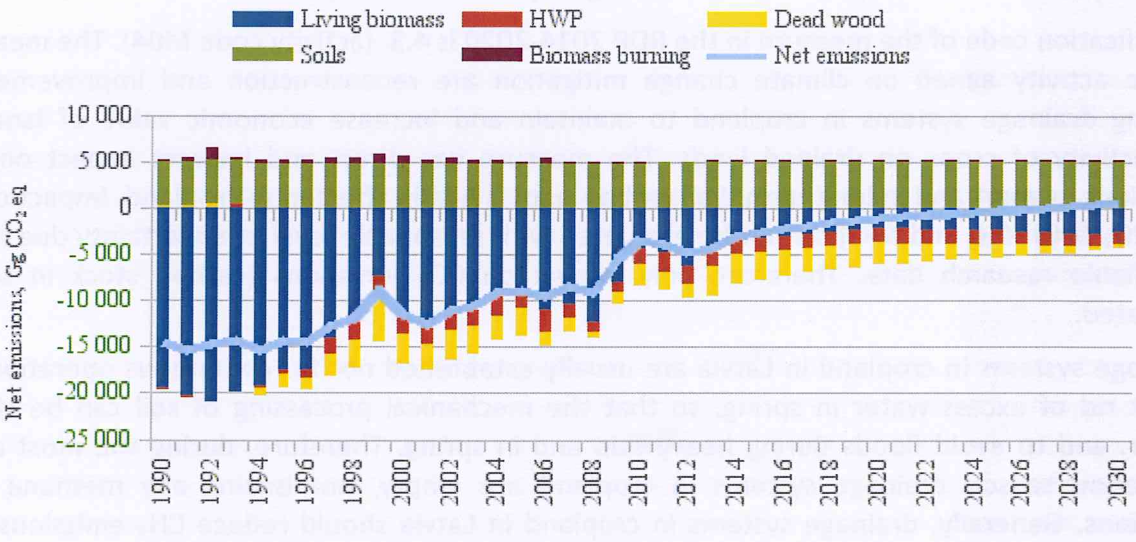

Figure 11: Projections of the GHG emissions in forest land in WAM scenario.

List of measures

The climate change mitigation measures in LULUCF sector, which are planned to be implemented in Latvia, are designated on the base of consultations with non-governmental organizations and taking into account national circumstances, in order to pursue the mitigation potential and contribute to implementation of other policies and ecosystem services, like biological diversity and water protection.

Measures in cropland

Recognizing importance of GHG mitigation in agriculture, Latvia has started to elaborate scientific and strategic background – various research programs with national and outsource (e.g. European Economic Area Financial Mechanism) funding related to agricultural GHG mitigation and adaptation to climate changes. Research results will be delivered in coming years, but right now Latvia has no nationally developed cost effective agricultural GHG mitigation strategy and deep knowledge in quantifying GHG abatement potential of different measures targeted to GHG mitigation.

Development and adaptation of drainage systems in cropland

Identification code of the measure in the RDP 2014-2020 is 4.3. (activity code M04). The measures of the activity aimed on climate change mitigation are reconstruction and improvement of existing drainage systems in cropland to maintain and increase economic value of land and productivity of crops on drained lands. The measure has direct and indirect impact on GHG emissions in short and in long term. Soil carbon pool is highly affected in cropland. Impact on the non-CO_2 GHG (CH_4 and N_2O) cannot be evaluated with reasonable level of uncertainty due to lack of reliable research data. Therefore only impact on CO_2 emissions (carbon stock in soil) is evaluated.

Drainage systems in cropland in Latvia are usually established not for continuous operation, but to get rid of excess water in spring, so that the mechanical processing of soil can be started earlier, and to avoid floods during heavy rain and in spring. Therefore, during the most of the vegetation season drainage systems in cropland are empty, not issuing any methane (CH_4) emissions. Generally, drainage systems in cropland in Latvia should reduce CH_4 emissions from soil, because they are aimed to reduce the share of time in the vegetation season, when anaerobic conditions are dominating in soil; however, no research data are available to quantify this effect.

The direct impact in cropland is associated with accumulation of CO_2 in soil carbon pool due to higher productivity of the drained fields and application of more advanced management practices in agriculture. The evaluation of impact of the reconstruction of the drainage ditches considers, that the measure will be implemented in cropland remaining cropland, particularly, extensively managed cropland, where poor conditions of drainage systems shorten active vegetation season or production of agricultural crops is possible only if weather conditions in spring are favourable. No support to the reconstruction of drainage systems is considered in grassland remaining grassland, except for cropland areas, where it is technically impossible to restore drainage systems without affecting grassland. Considering the flat landscape in Latvia, such situation may appear in many cases; however, other measures will be implemented to avoid conversion of grassland to cropland. Similarly, no support is considered for reconstruction of drainage systems on organic soils, except for cases, where expansion of closed drainage systems is favoured instead of open ditches to reduce CH_4 emissions. Additional support is earmarked to the establishment of certain environment protection targeted elements in drainage systems, like small ponds or constructed wetlands before the exhaust to suppress DOC emissions. However, no technical requirements for such installations in farmlands exist until now in Latvia and no research results approve the proposed positive impact. Additional studies are necessary to identify the impact of the additional drainage installations on DOC and CH_4 emissions and elaboration of instructions for maintenance of these installations, and to avoid the situation, when additional CH_4 emissions from ditches exceeds reduction of DOC emissions from drained fields.

Important indirect impact of the reconstruction of drainage systems in cropland is concentration of production – more fertile cropland will be available without land use changes, so the need and willingness to convert grassland or forest land to cropland to increase production will be reduced by economic drivers. However, this impact is not evaluated yet and it strongly depends on the development of food market (if there is a need for increased crop production).

At the national level, the measure will be implemented in 2015-2020, following approval of the relevant policy documents and guidelines. The policy framework of the measure is not yet completed; however, it will be elaborated on the basis of regulations, which are relevant to implementation of the RDP.

Considering the high uncertainty of impact on non-CO_2 emissions, only carbon stock changes (CO_2 emissions) in soil due to application of different management system are considered in the evaluation of the impact of reconstruction of drainage systems in cropland. Tier 1 method described in the IPCC guidelines for AFOLU sector (Eggleston *et al.*, 2006) is applied to compare carbon stock changes in soil in case of maintenance of the drainage systems in the cropland in good conditions and in current situation. Initial carbon stock in soil is considered to be equal to the value characteristic for high activity clays (HAC soils) in temperate region – 95 tonnes ha^{-1} at 0-30 cm deep soil layer. Basic scenario – current situation – considers continuous tillage in long term cultivated cropland with moderate input of organic material in soil (carbon stock change factor for land use 0.69, for tillage 1.0 and for input of organic material 1.0). The resulting carbon stock in soil before implementation of the proposed scenarios is 65.6 tonnes C ha^{-1}.

The comparison of existing situation and the situation after reconstruction of the drainage ditches considers a higher input of organic material (carbon stock change factor due to the organics input 1.1) after the drainage due to higher productivity and application of more fertilizers. Respectively, no carbon stock changes in soil are considered, if the current situation persists, and increase of the soil carbon stock is considered after the reconstruction of the drainage systems. Summary of comparison of the both scenarios is shown in Table 3; 20 years' transition period is considered in calculation. Implementation of the measure according to the tier 1 method will contribute to the net CO_2 removals in soil – **1.32 tonnes CO_2 ha^{-1} annually** (26.4 tonnes CO_2 ha^{-1} in total) during 20 years' period after implementation of the measure. However, more studies are necessary to evaluate the proposed, as well as non-evaluated impacts, particularly on non-CO_2 gases, of the measure on the basis of scientific results. Additional research is necessary also to identify conditions, where the implementation of the measure is the most beneficial and to elaborate guidelines for reconstruction of the drainage systems in croplands. Summary of the impact of the measure is provided in Table 4.

Table 3: Summary of comparison of scenarios of reconstruction of drainage systems on cropland

Parameter	Measurement unit	Current situation	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	7.21	
Annual soil carbon stock changes	tonnes C ha^{-1} year	0.36	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} year	1.32	

Table 4: Summary of impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	4.6
Total GHG reduction potential	tonnes CO_2 eq	122024
Average annual GHG reduction potential per area unit	tonnes CO_2 eq $year^{-1}$	6101
	tonnes CO_2 eq $year^{-1}$ ha^{-1}	1.32

Support to introduction and promotion of integrated horticulture

Identification code of the measure in the RDP is 10.1.2. (activity code M10). The measure applies to the establishment of new orchards on existing cropland.

Implementation of the measure will affect carbon stock in living biomass and soil carbon pool; respectively, it will reduce CO_2 emissions. Change of the land management system, particularly, establishment of continuous ground vegetation, will affect N_2O and CH_4 emissions; however, existing methods are not sufficient to predict these emissions in diverse growth conditions.

At the national level, the measure will be implemented in 2015-2020. The impact of the measure is projected for the 20 years' period for soil and 30 years – for living biomass carbon pools. The policy framework of the measure is not yet completed. It will be elaborated on the basis of regulations, which are relevant to the implementation of the RDP.

The quantitative estimation of impact of the measure is done according to the tier 1 method of the IPCC good practice guidelines for LULUCF sector (Penman, 2003). Carbon stock in living biomass after the transition period is calculated according to the Table 3.3.2 of the guidelines "Default coefficients for aboveground woody biomass and harvest cycles in cropping systems containing perennial species" – 63 tonnes C ha^{-1} in above-ground biomass with the average accumulation rate of 2.1 tonnes C ha^{-1} annually. Transition period according to the guidelines is 30 years. Initial carbon stock in soil is considered 95 tonnes ha^{-1} (HAC soils in temperate region). Soil carbon stock change factors for land use, tillage and input are adopted from the recent guidelines (cropland – 0.69, regular tillage – 1.0 and moderate input – 1.00, Eggleston *et al.*, 2006); respectively, before implementation of the measure average carbon stock in soil is 65.6 tonnes C ha^{-1}. Impact of reduced tillage is displayed in soil carbon stock changes (Table 5).

Implementation of the measure according to the tier 1 method will contribute to the net CO_2 removals in soil – **8.9 tonnes CO_2 ha^{-1} annually** (267 tonnes CO_2 ha^{-1} in total) during 30 years' period after implementation of the measure. More studies are necessary to evaluate the impact on emissions of the non-CO_2 gases and carbon stock change in soil due to change of the management system.

Table 5: Summary of comparison of scenarios of establishment of new orchards

Parameter	Measurement unit	Current situation	Implementation of measure
Carbon stock change factor – tillage	-	1.00	1.15
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	75.4
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	9.83	
Annual soil carbon stock changes	tonnes C ha^{-1} year	0.49	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} year	1.80	
Carbon stock changes in living biomass			
Carbon stock at the end of transition period	tonnes C ha^{-1}	63	
Transition period	years	30	
Average annual carbon stock changes	tonnes C ha^{-1} year	2.1	
Average annual net CO_2 removals	tonnes CO_2 ha^{-1} year	7.7	
Carbon stock changes in living biomass and soil			
Average net CO_2 removals in 30 years period	tonnes CO_2 ha^{-1} year	8.9	
Total net CO_2 removals in 30 years period	tonnes CO_2 ha^{-1}	267	

No additional emissions due to establishment of the new orchards in existing cropland are considered, because other measures, like the reconstruction of drainage systems in cropland, will secure availability of land to maintain or even increase crop production, replacing lands, which are utilized for establishment of the orchards. Summary of the impact of the measure is provided in Table 6.

Table 6: Summary of cost and impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	0.5
Total GHG reduction potential	tonnes CO_2 eq	133526
Average annual GHG reduction potential per area unit	tonnes CO_2 eq year^{-1}	4451
	tonnes CO_2 eq year^{-1} ha^{-1}	8.9

Certain reduction of the GHG emissions can be reached by establishment of the cranberries plantations on abandoned peatlands with nutrients poor surface layer, if compared to management of these lands for crop production or grassland management. According to the Wetlands supplement (Blain *et al.*, 2013) peatlands on poor sphagnum peat produces 36 114 kg CO_2 eq. ha^{-1}, if managed as cropland, 22 575 kg CO_2 eq. ha^{-1}, if managed as grassland and 6363 kg CO_2 eq. ha^{-1}, if managed for cranberries production or set aside after closure of drainage systems. Reduction of the GHG emissions can be considered in the case, if the area is continuously saturated with water. Periodic saturation with water may even increase the GHG emissions from soil according to the studies in Nordic countries (Salm, 2012). Due to high uncertainty and specific conditions necessary to secure the reduction of the GHG emissions, establishment of plantations of cranberries is not considered as a climate change mitigation targeted measure. The country specific data on the GHG emissions from soil in the plantations of cranberries and other realistic scenarios of management of the peatlands has to be elaborated to contribute to further evaluation of the wetlands management in light of the climate change mitigation.

Support to stubble field in winter period

Identification code of the measure in the RDP is 10.1.3. (activity code M10). The measure considers the use of more extensive crop rotation in cropland, including use of green manure, to secure higher inputs of organic material into soil. It will be implemented in intensively managed cropland for medium input of organic material (the carbon stock change factor for input equals to 1.0, Eggleston *et al.*, 2006). After application of the measure, the management system in the affected fields will be changed to "High, without manure" according to the IPCC guidelines for AFOLU sector; respectively the carbon stock change factor for input will increase to 1.11. No GHG emissions are considered due to land use changes (conversion of grassland to cropland or deforestation) after implementation of the proposed extensive cropland management approaches, because the negative impact of the activity on crop production will be compensated by intensification of production on extensively managed cropland. This solution is economically driven, because in the most cases adaptation of cropland for more intense use will be cheaper than land use change from grassland or forest land.

The measure will impact CO_2 and N_2O emissions from soil; however, only carbon stock changes in soil are reported under the LULUCF sector. In agricultural sector utilization of green manure will increase N_2O emissions; however, the impact might not be significant in comparison to accumulation of carbon in soil if no additional nitrogen fertilizers are used to grow the green manure plants.

The measure will be implemented in 2015-2020 and applied at the national level within the scope of the RDP. The policy framework of the measure will be elaborated on the basis of regulations, which are relevant to implementation of the RDP. Duration of the impact of the activity is considered 20 years.

Summary of comparison of the both scenarios (conventional cropping system and extensive crop rotation with additions of green manure) is shown in Table 7; 20 years' transition period is considered in calculation of soil carbon stock changes. Implementation of the measure according to the tier 1 method will contribute to the net CO_2 removals in soil – **1.32 tonnes CO_2 ha^{-1} annually** (26.4 tonnes CO_2 ha^{-1} in total) during 20 years' period after implementation of the measure. Summary of the impact of the measure is provided in Table 8.

Table 7: Summary of comparison of scenarios of reconstruction of drainage systems on cropland

Parameter	Measurement unit	Current situation	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	7.21	
Annual soil carbon stock changes	tonnes C ha^{-1} year	0.36	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} year	1.32	

Table 8: Summary of cost and impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	25
Total GHG reduction potential	tonnes CO_2 eq	660963
Average annual GHG reduction potential per area unit	tonnes CO_2 eq $year^{-1}$	33048
	tonnes CO_2 eq $year^{-1}$ ha^{-1}	1.32

Growing of papilionaceous plants (legumes)

Identification code of the measure in the RDP is 10.1.5. (activity code M10). The measure considers use of legumes in mixture with other crops in cropland, considering higher inputs of organic material into soil and partial replacement of mineral fertilizers with nitrogen fixing plants. It will be implemented in the intensively managed cropland with medium input of organic material (the carbon stock change factor for input equals to 1.0, Eggleston *et al.*, 2006). After application of the measure the management system in the affected fields, will be changed to "High, without manure" according to the IPCC guidelines for AFOLU sector and the carbon stock change factor for input will increase to 1.11. In spite of a possible reduction of productivity of the primary target crops in the affected fields no GHG emissions are considered due to land use changes (conversion of grassland to cropland or deforestation) after implementation of the measure, because the negative impact of the activity on the crop production will be compensated by intensification of production on extensively managed cropland.

The measure will impact CO_2 emissions from soil. No research data exists to report possible impact on N_2O emissions; however, N_2O emissions from soil reported under agricultural sector might increase due to higher total input of nitrogen, if no decrease of the primary target crop is considered.

The measure will be implemented in 2015-2020 at the national level within the scope of the RDP. The policy framework of the measure will be elaborated on the basis of regulations, which are relevant to implementation of the RDP. Duration of the impact of the activity is considered 20 years.

Summary of comparison of the both scenarios (conventional cropping system and use of the legumes and the primary target crops) is shown in Table 9; 20 years' transition period is considered in calculation of soil carbon stock changes. Implementation of the measure according to the tier 1 method will contribute to the net CO_2 removals in soil – **1.32 tonnes CO_2 ha^{-1} annually** (26.4 tonnes CO_2 ha^{-1} in total) during 20 years' period after implementation of the measure. Summary of the impact of the measure is provided in Table 10.

Table 9: Summary of comparison of scenarios of reconstruction of drainage systems in cropland

Parameter	Measurement unit	Current situation	Implementation of measure
Carbon stock change factor – input	-	1.00	1.11
Carbon stock in soil 0-30 cm at the end of transition period	tonnes C ha^{-1}	65.6	72.8
Total impact of the measure on soil carbon stock	tonnes C ha^{-1}	7.21	
Annual soil carbon stock changes	tonnes C ha^{-1} year	0.36	
Annual removals of CO_2 in soil	tonnes CO_2 ha^{-1} year	1.32	

Table 10: Summary of cost and impact of the measure

Parameter	Measurement unit	Value
Total cost in the planning period	EUR	To be updated
Total affected area	kha	50
Total GHG reduction potential	tonnes CO_2 eq	1321925
Average annual GHG reduction potential per area unit	tonnes CO_2 eq year^{-1}	66096
	tonnes CO_2 eq year^{-1} ha^{-1}	1.32

Greening of cropland

Identification code of the measure in the RDP is 10.1.7. (activity code M10). Leaving a certain area of cropland out of conventional cropping system, if the area is not afforested or used for perennial crop production, in general will not lead to reduction of the GHG emissions or increase of CO_2 removals, because reduction of the field size in one place should be compensated by increase of a field area in other place to maintain production, if no other productivity measures are applied. However, there is an option to reduce GHG emissions by reduction of management activities on organic soil. No additional support is considered for conversion of organic soil; therefore, in the impact calculation it is assumed, that share of cropland on organic soil left for greening purposes will be equal to share of organic soils in cropland.

Conversion of cropland on organic soil to grassland will reduce CO_2 and N_2O emissions. According to the 2013 Wetlands supplement to the IPCC guidelines for AFOLU sector CO_2 emissions from cropland on organic soil in temperate climatic zone equals to 28.97 tonnes CO_2 ha^{-1} annually, the emissions from grassland on organic soil in temperate climatic zone equals to 22.37 tonnes CO_2 ha^{-1} annually, respectively, the land use changes from cropland to grassland on organic soil reduce the CO_2 emissions by 6.6 tonnes CO_2 ha^{-1} annually. Conversion of 1 ha of cropland to grassland considering 5.18% share of organic soils would reduce CO_2 emissions by **0.3 tonnes CO_2 ha^{-1} annually.**

The measure will be implemented in 2015-2020 at the national level within the scope of the RDP. The policy framework of the measure is not yet completed. It will be elaborated on the base of regulations, which are relevant to implementation of the RDP. Duration of the impact of the activity depends from carbon stock in organic soil in transformed cropland on organic soil. In calculations the impact is considered equal to 20 years; however, it continues as long as the field is not returned to crop production. Summary of the impact of the measure is provided in Table 11.

Table 11: Summary of impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	-
Total GHG reduction potential	tonnes CO_2 eq	-
Average annual GHG reduction potential per area unit	tonnes CO_2 eq $year^{-1}$	-
	tonnes CO_2 eq $year^{-1}$ ha^{-1}	0.9

Measures in forest land

Development and adaptation of forestry infrastructure

Identification code of the measure in the RDP 2014-2020 is 4.3. (activity code M04). The measures of the activity aimed on climate change mitigation are reconstruction and improvement of existing drainage systems in forest land to maintain and increase economic value of land and productivity on drained lands. The measure has a direct and indirect impact on GHG emissions in short and in long term. Living and dead biomass carbon pool is highly affected in forest land. Impact on the non-CO_2 GHG (CH_4 and N_2O) cannot be evaluated with reasonable level on uncertainty due to lack of reliable research data. Therefore only impact on CO_2 emissions (carbon stock in soil) is evaluated.

The scope of the measure is to maintain existing forest drainage systems, particularly, to secure successful forest regeneration after final felling. Mature stands reaching final felling age and recently regenerated forest stands are prioritized in this activity to reach maximum economical and the GHG emissions reduction effect.

Drained forest in Latvia is classified according to the soil parent material – drained forests on peat soil and on mineral soil. Drainage ditches on peat soil usually transport water during the whole vegetation season due to groundwater outputs, drainage systems on mineral soils can be similar to those on peat soil, as well as similar to drainage systems on farmlands – temporarily filled with excess water in spring and during heavy rainfalls; therefore, the structure of CH_4 emissions from ditches might differ, depending on the dominating parent material. Forests are normally drained with open drainage systems, which are regularly maintained, and a complete cleaning and restoration of the whole ditch network is usually done once every 30 years. However, additional increment after restoration of the drainage systems normally appears only in young stands.

Forest drainage is one of the most efficient solutions to increase CO_2 removals in living biomass and other carbon pools in forest lands. The research data on impact of drainage of organic soils demonstrates controversial results; for instance, 51 years long monitoring of impact of drainage and afforestation of a transitional bog in central part of Latvia demonstrates a significant increase of carbon stock in all carbon pools, including soil. However, during the first 15 years after drainage, the study area was the source of emissions (Lazdiņš *et al.*, 2014). The IPCC guidelines considers that soil is the source of CO_2 emissions in all forests on organic soils, the factor of CO_2 emissions according to the guidelines is 0.68 tonnes C ha^{-1} annually (Eggleston *et al.*, 2006). According to the guidelines for GHG accounting from wetlands, the CO_2 emissions from soil in rich rewetted organic soils in temperate climatic zone are 0.5 tonnes C ha^{-1} annually (Blain *et al.*, 2013); respectively, difference between soil carbon stock changes in the forest area with maintained drainage system and rewetted area on organic soil is 0.18 tonnes C ha^{-1} annually.

Drainage also affects N_2O emissions, the increase of the N_2O emissions by 0.60 kg N_2O-N ha^{-1} annually is considered for drained organic soil and by 0.06 kg N_2O-N ha^{-1} annually – in drained mineral forest soils (Penman, 2003). The uncertainty of these factors is very high, comparing the source data and other publications (Maljanen *et al.*, 2003; Mander *et al.*, 2010; Ojanen *et al.*, 2013). Drainage of forest causes reduction of the CH_4 emissions (von Arnold *et al.*, 2005; Matson *et al.*, 2009; Mander *et al.*, 2010); however, uncertainty of these estimates is very high and strongly depends on the initial conditions, which cannot be determined anymore in most cases. No impact on N_2O and CH_4 emissions is used in calculation of the effect of the drainage system reconstruction in forest lands, considering high uncertainty of these estimates.

The most of the forest drainage systems in forest land in Latvia are established before 1990. Proposed lifetime of a drainage system is 30 years; consequently, the most of the drainage systems are outdated. However, in spite of declining of technical conditions of the drainage systems, the drained generation of trees usually continues to grow following increment curves, characteristic for naturally dry forest or even better due to the water regime self-regulating functions. The growth rate can be disturbed by natural ageing of the forest stands, regenerative felling or intensive thinning, as well as due to severe changes in growth conditions like flooding of an area by beavers. The most common reason for "switching off" self-regulation of water regime in Latvia is regenerative felling. Therefore, it is important to prioritize reconstruction of drainage systems in mature stands before regenerative felling and young stands to secure that growth of the second generation of trees on drained lands follows the growth curves characteristic for naturally dry and drained forests.

An example of two scenarios – drained and wet organic soil is shown in Figure 12. It is considered, that in case of reconstruction of the forest drainage systems in pine stands, the development of the second rotation of trees will follow the blue columns and in case of rewetting – red columns in Figure 12.

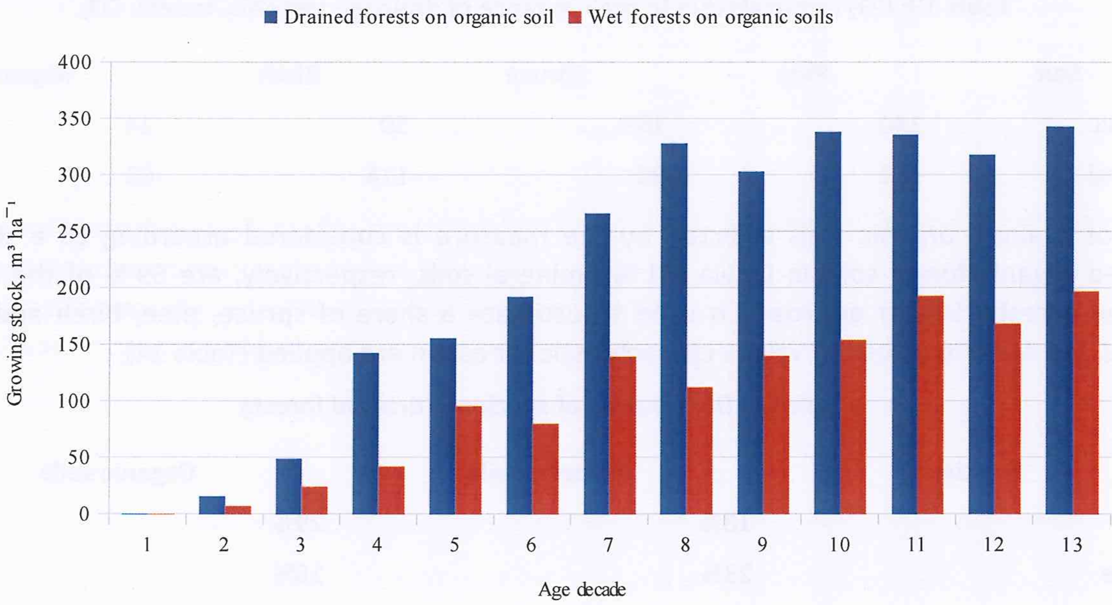

Figure 12: Growing stock in drained and naturally wet pine stands on organic soils

The carbon stock change in dead wood and litter carbon pools is not considered in the calculation due to high uncertainty of the research data. Considerable increase of carbon stock in these pools are found in long term studies in Latvia (Lazdiņš *et al.*, 2014); however, these removals strongly depend on the initial conditions in the drained area, which usually cannot be identified.

The difference between both scenarios is accounted as a difference between growing stock in a typical final felling age for the species, which are the most common in drained forests (pine, spruce, birch, aspen). Summary of impact of maintenance of drainage systems on the growing stock is provided in Table 12. The duration of the impact is considered equal to an average rotation for particular species – 101 year for pine, 81 year for spruce, 71 year for birch and 51 year for aspen. Biomass expansion factors and carbon content in biomass applied in the calculation are derived from the GHG inventory report.

Table 12: Impact of maintenance of drainage systems on growing stock

Parameter	Pine	Spruce	Birch	Aspen
Drained organic soils				
Net changes in living biomass, tonnes CO_2 yearly	2.05	2.75	1.36	0.93
Emissions from soil, tonnes CO_2 yearly	0.66	0.66	0.66	0.66
Net changes, tonnes CO_2 yearly	1.39	2.09	0.7	0.27
Drained mineral soils				
Net changes, tonnes CO_2 yearly	1.5	1.11	1.6	1.63

The CO_2 removals during the rotation period in case of maintenance of the drainage systems reach values provided in Table 13. Additional removals can be considered in the harvested wood products due to commercial thinning (about 30 % of the growing stock in mature stands).

Table 13: CO_2 removals due to maintenance of drainage systems, tonnes CO_2

Soil	Pine	Spruce	Birch	Aspen
Organic	140	169	50	14
Mineral	152	90	114	83

Area of drained organic soils affected by the measure is considered according to a share of drained organic forest soils in Latvia (41 %); mineral soils, respectively, are 59 % of the area of drained forests. Similar approach is used to estimate a share of spruce, pine, birch and aspen stands. For other species the values characteristic for aspen are applied (Table 14).

Table 14: Distribution of species in drained forests

Species	Mineral soils	Organic soils
Pine	18%	29%
Spruce	23%	16%
Birch	27%	38%
Aspen and others	32%	17%

The measure will be implemented in 2015-2020 at the national level, following approval of the relevant policy documents and guidelines. The policy framework of the measure will be elaborated on the basis of regulations, which are relevant to implementation of the RDP.

The average annual impact of the measure on CO_2 removals is 1.3 tonnes CO_2 ha^{-1} and the average impact during the rotation period is 99 tonnes CO_2 ha^{-1}. Summary of the impact of the measure is provided in Table 15.

Table 15: Summary of impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	12
Total GHG reduction potential	tonnes CO_2 eq	1181825
Average annual GHG reduction potential per area unit	tonnes CO_2 eq $year^{-1}$	15612
	tonnes CO_2 eq $year^{-1}$ ha^{-1}	1.3

Afforestation and improvement of stand quality in naturally afforested areas

Identification code of the measure in the RDP is 8.1. (activity code M08). The scope of afforestation is economically and environmentally efficient utilization of former farmlands (mainly abandoned pastures), which are not any more used for food of fodder production. This is the most efficient climate change mitigation measure in the RDP.

The afforestation secures accumulation of CO_2 in living and dead biomass, litter and soil (only in less fertile and depleted soils). The growth conditions in afforested lands usually are similar to fertile forest stand types on drained or naturally dry mineral soils; therefore, the calculation of impact of afforestation on carbon stock in living and dead biomass is done on the basis of average values in *Hylocomiosa* stand type (Table 16), estimating the carbon stock in these pools at the end of rotation period (101 year for pine, 81 – spruce, 71 – birch and 51 year for aspen). Carbon stock changes in litter are 0.37 tonnes CO_2 ha^{-1} annually during 150 years period, according to the calculation method applied in the GHG inventory.

Reduction of CO_2 and N_2O emissions from soil due to land use change from cropland or grassland to forest land is not accounted, considering that there are no benefits proposed in the RDP for afforestation of organic soil.

Table 16: Average annual net CO_2 removal in living and biomass in *Hylocomiosa* stand type

Dominant species	Average annual net removal of CO_2 in living biomass, tonnes of CO_2	Average annual net removal of CO_2 in dead biomass, tonnes of CO_2
Aspen	5.78	0.42
Birch	7.53	0.77
Spruce	5.87	0.53
Pine	5.29	0.47

The distribution of the tree species in afforested areas in the impact calculation is considered according to the average historical values published by the State Forest Service (Figure 13).

In average, afforestation of 1 ha will contribute to removal of 596 tonnes of CO_2 during the rotation or 7.4 tonnes of CO_2 annually.

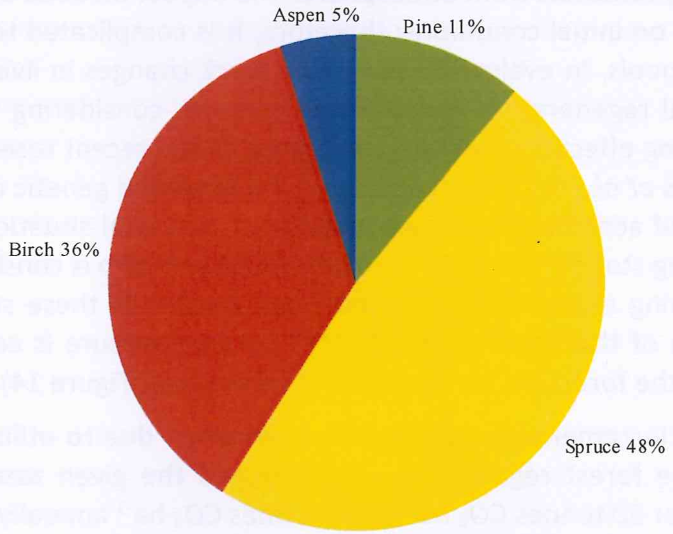

Figure 13: Dominant species in afforested lands

Summary of the impact of the measure is provided in Table 17. Total reduction impact of the measure will be nearly 4 million tonnes of CO_2 or 0.05 million tonnes of CO_2 in average annually. The measure will be implemented in 2016-2020 at the national level within the scope of the RDP. The policy framework of the measure is based on already existing forest management rules and the legal documents, which have to be elaborated for implementation of the RDP. Duration of the impact of the activity is 150 years; however, the most of the contribution will be reached during the first 50 years.

Table 17: Summary of impact of the measure

Parameter	Measurement unit	Value
Total affected area	ha	6 600
Total GHG reduction potential	tonnes CO_2 eq	3 935 472
Average annual GHG reduction potential per area unit	tonnes CO_2 eq year^{-1}	48 666
	tonnes CO_2 eq year^{-1} ha^{-1}	7.4

Regeneration of forest stands after forest fires and other natural damages and preventive measures in forests

Identification code of the measure in the RDP is 8.3./8.4. (activity code M08). Two measures are considered under this activity – regeneration of forest stands after forest fires and other natural disasters, and maintenance and improvement of preventive system of the forest fires.

__Regeneration of forest stands after natural disasters__

The measure considers support to regeneration of forests after natural disasters, like forest fires and strong storms, as well as to reconstruction of diseasing valueless forest stands. The measure will affect carbon stock in living biomass, dead wood, litter and soils carbon pools; respectively, it is aimed to increase CO_2 removals from atmosphere. The impact on dead biomass and soil carbon pools strongly depends on initial conditions; therefore, it is complicated to predict the impact of the measure on these pools. In evaluation of carbon stock changes in living biomass 2 scenarios are compared – natural regeneration and planting of trees, considering that planted trees will grow faster. The breeding effect is considered according to the recent research results (Jansons & Baumanis, 2008; Lazdiņš *et al.*, 2012b, 2013). Use of the improved genetic material in the planting production is considered according to expert judgement on a real situation in the market (Table 18). The average growing stock in the natural regeneration scenario is considered according to the average values of growing stock of the most common species in these stand types at the final felling age. Distribution of the stand types affected by the measure is considered equal to the average distribution of the forest stands damaged in forest fires (Figure 14).

The average additional increment of stem wood per rotation due to utilization of the improved planting material in the forest regeneration according to the given assumptions is 43 m^3 ha^{-1} (0.47 m^3 ha^{-1} annually) or 60 tonnes CO_2 ha^{-1} (0.59 tonnes CO_2 ha^{-1} annually).

Additional studies are necessary to evaluate impact of the measure on other carbon pools, like dead biomass and soil, especially in areas suffered from forest fires.

Table 18: Assumptions for estimation of breeding effect on additional increment

Species	Impact of breeding on growing stock before final felling	Share of improved seed material in planting production
Birch	15%	100%
Spruce	20%	60%
Pine	15%	100%

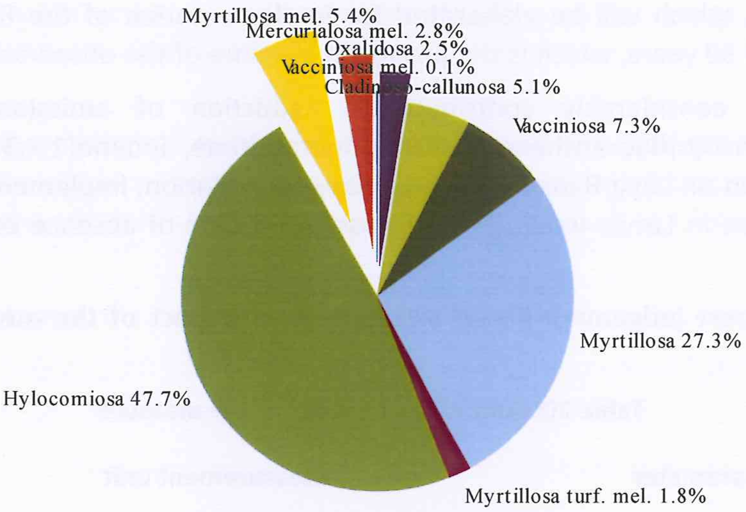

Figure 14: Distribution of the forest stand types in recent forest fire statistics

Summary of the impact of the measure is provided in Table 19. The measure will be implemented in 2015-2020 at the national level within the scope of the RDP. The policy framework of the measure is based on already existing forest management regulations (Latvijas Republikas Saeima, 2000; Ministru Kabinets, 2012b). Duration of the impact of the activity is 100 years; however, the most of the contribution will be reached during the first 50 years.

Table 19: Summary of impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	31
Total GHG reduction potential	tonnes CO_2 eq	1862524
Average annual GHG reduction potential per area unit	tonnes CO_2 eq year^{-1}	18195
	tonnes CO_2 eq year^{-1} ha^{-1}	0.59

Preventive measures of forest damages

The scope of the measure is to maintain forest fire prevention system, including reconstruction of existing and building of new fire observation towers. The potential impact of the measure on the GHG emissions is not evaluated yet; however, it is well known that the towers are very efficient in early identification and localization of the forest fires, hence the area of the forest fires is considerably smaller than it would be if the fire prevention system did not exist. Therefore, the scenario with and without fire prevention system are compared to evaluate climate change mitigation effect of this measure.

The measure affects CO_2, CO, CH_4, N_2O and NO_x emissions. The GHG emissions due to forest fires in Latvia are 133 tonnes CO_2eq. ha^{-1}, including 117 tonnes of CO_2 emissions, 14 tonnes CO_2eq. of CH_4 emissions and 3 tonnes CO_2eq. of N_2O emissions. The total annual GHG emissions in forests due to forest fires in Latvia are very fluctuating; the average annual GHG emissions since 1990 are 147 kilotons CO_2eq.

The measure will be implemented in 2015-2020 at the national level within the scope of the RDP. The policy framework of the measure is based on already existing forest management regulations and regulatory acts, which will be elaborated for implementation of the RDP. Duration of the impact is considered 30 years, which is the proposed life-time of the observation towers.

The measure will considerably contribute to reduction of emissions of the Dioxins, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene reported under the Convention on Long-Range Transboundary Air Pollution. Implementation of the targets set in this convention in Latvia would not be possible in case of absence of efficient forest fire prevention system.

Summary of the expert judgement-based assumption of impact of the measure is provided in Table 20.

Table 20: Summary of impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	-
Total GHG reduction potential	tonnes CO_2 eq	-
Average annual GHG reduction potential per area unit	tonnes CO_2 eq year^{-1}	-
	tonnes CO_2 eq year^{-1} ha^{-1}	133.4

Improvement of ecological value and sustainability of forest ecosystems

Identification code of the measure in the RDP is 8.5. (activity code M08). The scope of the measure is to support pre-commercial thinning of young stands in private forests to secure implementation of sustainable forest management practices (Jansons & Zālītis, 1998; Zālītis, 2004; Zālītis & Lībiete, 2008; AS "Latvijas valsts meži", 2012) aimed to increase economic and ecological value of forests in long term. The principles of the sustainable thinning of young forest stands are proposed in the national legal documents on forest management (Latvijas Republikas Saeima, 2000; Ministru Kabinets, 2012a). The basic for these principles is more intensive pre-commercial thinning to boost increment in following decades and to reduce the need for additional commercial thinning before the final felling. The activity is not mandatory, hence the forest owners usually avoid it to save money and wait until trees reach the threshold dimensions for economically feasible commercial thinning, thus losing potential additional increment and providing favourable conditions for spreading of forests pests and diseases in weakened stands.

Pre-commercial thinning has short and long term impact. The short impact is a transfer of certain portion of the carbon from living biomass to the dead biomass pool with following conversion into CO_2 during 20 years according to Tier 1 approach. The long term impact is increase of growing rate (by 15 % annually in average, according to an expert judgement used in some growth models). Contribution to the dead wood stock is not evaluated yet, therefore, only living biomass is considered in the impact assessment.

The climate change mitigation effect of the pre-commercial thinning is calculated as the difference between growing stock at the end of the rotation period and the difference in timber stock extracted in the commercial thinning. The growth models are derived from recent research data (Zālītis, 2006; Zālītis & Jansons, 2009; Zālītis *et al.*, 2014). The biomass expansion factors are taken from the GHG inventory report.

The net impact of the intensified pre-commercial thinning in comparison to standard forest management practice in private forests is summarized in Table 21. The most efficient, as a climate change mitigation measure, pre-commercial thinning is in spruce stands. It is considered in the impact assessment, that the distribution of the dominant species (pine, spruce, birch and others) in stands, where the measure will be implemented, is equal to distribution of these species in the previously thinned stands in private forests. The impact on other species is accounted under the birch stands (Figure 15).

Table 21: Net impact of the pre-commercial thinning on growing stock in pine, spruce and birch forests

Parameter	Pine	Spruce	Birch
Additional increment, m^3 ha^{-1} annually	1.52	2.88	0.7
Additional CO_2 removals, tonnes ha^{-1} annually	1.94	3.5	1.0
Additional CO_2 removals, tonnes ha^{-1} per rotation	194	280	72

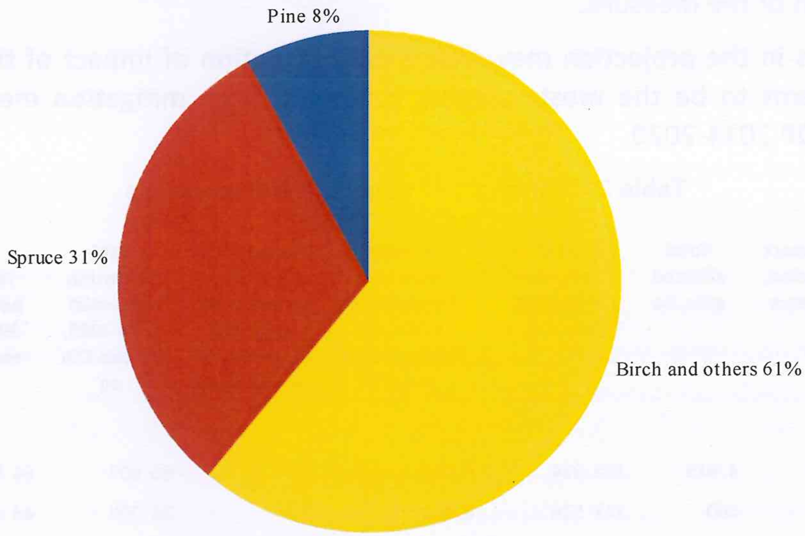

Figure 15: Dominant species in thinned lands in private forest

The average impact of the measure is additional increment of 1.4 m^3 ha^{-1} stem wood or additional removals of 1.9 tonnes CO_2 ha^{-1} annually resulting in net additional removals of 146 tonnes CO_2 ha^{-1} per rotation.

Summary of the impact of the measure is provided in Table 22. The measure will be implemented in 2015-2020 at the national level within the scope of the RDP. The policy framework of the measure is based on already existing forest management regulations and the legal documents which have to be elaborated for the implementation of the RDP. Duration of the impact of the activity is 100 years; however, the most of the contribution will be reached during the first 50 years.

Table 22: Summary of cost and impact of the measure

Parameter	Measurement unit	Value
Total affected area	kha	15
Total GHG reduction potential	tonnes CO_2 eq	2196836
Average annual GHG reduction potential per area unit	tonnes CO_2 eq $year^{-1}$	28056
	tonnes CO_2 eq $year^{-1}$ ha^{-1}	1.9

Projection of results of implementation of measures

Net reduction of GHG emissions

The net impact of the proposed measures is 12 136 kilotons CO_2, excluding the forest fire prevention system; the total affected area – 185 kha; the average annual impact is 1.4 tonnes CO_2 ha^{-1} (256 kilotons CO_2 eq. $year^{-1}$ in all affected areas, Table 23). The most efficient measure is afforestation (486 kilotons tonnes CO_2 eq. $year^{-1}$); however, the total impact of this measure still has to be evaluated. According to Tier 1 based methodology, duration of the impact of the measures in cropland is 20-30 years; according to Tier 1 and Tier 2 based methodology, duration of impact of the measures in forest land is 76-102 years, (Eggleston *et al.*, 2006).

The most of the impact (66 %) is expected after 2030 due to long lasting effect of the measures in affected forest lands. The mean annual impact is calculated as an average – the total impact divided by duration of the measure.

Significant changes in the projection may arise from estimation of impact of the fire prevention system, which seems to be the most valuable climate change mitigation measure from those proposed in the RDP 2014-2020.

Table 23: Summary of impact of the measures

	Impact period, years	Total affected area, ha	Total GHG reduction potential, tonnes CO_2 eq	Annual GHG reduction potential per area unit, tonnes CO_2 eq $year^{-1}$	Annual GHG reduction potential per area unit, tonnes CO_2 eq year-1 ha^{-1}	GHG reduction potential until 2020, tonnes CO_2 eq	GHG reduction potential in 2021-2030, tonnes CO_2 eq	GHG reduction potential after 2030, tonnes CO_2 eq
Measures in cropland								
Cropland drainage	20	4 615	122 024	6 101	1,3	36 607	61 012	24 405
Establishment of orchards	30	500	133 526	4 451	8,9	26 705	44 509	62 312
Greening activities	20	40 000	273 504	13 675	0,3	82 051	136 752	54 701
Production of legumes	20	50 000	1 321 925	66 096	1,3	396 578	660 963	264 385
Extensive crop rotation	20	25 000	660 963	33 048	1,3	198 289	330 481	132 193
Measures in forestland								
Drainage in forest	76	11 971	1 181 825	15 612	1,3	93 670	156 117	932 038
Afforestation	81	6 600	3 935 472	48 666	7,4	291 995	486 658	3 156 820
Forest thinning	78	15 000	2 196 836	28 056	1,9	168 337	280 562	1 747 937
Forest regeneration	102	31 000	1 862 524	18 195	0,6	109 169	181 949	1 571 406
Total impact	-	184686	11 688 599	233 900	1,27	1 403 401	2 339 002	7 946 196

The most efficient measures are afforestation, forest thinning and regeneration of damaged and low valued forest stands (65 % of the total impact, Figure 16).

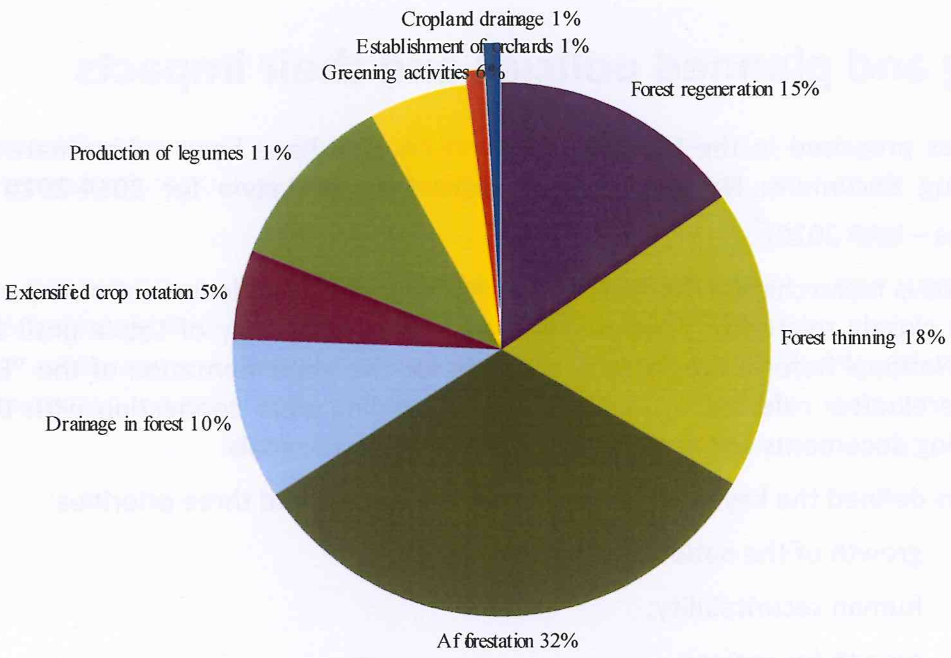

Figure 16: Share of the total impact of different measures

Impact on different source categories

The impact of the proposed measures on CO_2 emissions and removals is considered in the projection. The total impact in cropland according to Tier 1 methods is 2511 kilotons CO_2 (19 % of the total impact) and the total impact in forest land is 9 177 kilotons CO_2 (79 % of the total impact). The average impact is 21 tonne CO_2 ha^{-1} in cropland and 142 tonnes CO_2 ha^{-1} in forest land.

Existing and planned policies and their impacts

The measures proposed in the LULUCF sector action plan have been subordinated to medium term planning document: **National Development Plan of Latvia for 2014-2020** (hereinafter referred to as – NAP 2020)[6].

The NAP 2020 is hierarchically the highest middle term planning document at the national level. NAP 2020 is closely related to "Sustainable Development Strategy of Latvia until 2030" (Latvia 2030) and "National Reform Programme of Latvia for the Implementation of the "Europe 2020" strategy" (hereinafter referred to as NRP), thus providing clear connection with the European Union planning documents and the set priorities and thematic goals.

NAP 2020 has defined the keynote "Economic breakthrough" and three priorities:

- growth of the national economy;
- human securitability;
- growth for regions.

Priorities create mutually effective and unified system complying with approach of sustainable planning.

Measures to be included in the LULUCF action plan and their activities affect achievement of all three priority goals of NAP 2020 contributing to following directions of action of NAP 2020:

- highly Productive Manufacturing and Internationally Competitive Services with Export Potential;
- outstanding Business Environment;
- belonging to Latvia: Cooperation and Culture;
- promotion of Economic Activity in the Regions: Unleashing the Potential of Territories";
- availability of Services for Creating More Equal Work Opportunities and Living Conditions;
- sustainable Management of Natural and Cultural Capital.

Forest Policy

On the April 28, 1998, the Cabinet of Ministers of the Republic of Latvia adopted **the Forest Policy** as a compromise between all the parties involved in the forestry sector. The main goal defined in the policies is to ensure a sustainable management of Latvian forests and it is being accomplished by documents of policy planning and regulations: the Forest Law, Forest-based Sector Development Guidelines and other forest related regulations.

The Forest Policy underlines that forest is an important part of Latvian environment. In light of importance of forest in maintaining the environment, ensuring the social needs of society and in economics – the goals are:

6 http://www.nap.lv/

- to ensure that the area of forest is not decreasing by setting limits to the forest land transformation;
- to ensure maintenance and increase of productivity of forest lands;
- to encourage afforestation of agriculturally non-effective land.

By following these goals the increase of forest area and input in the national economy will be reached.

Forest Policy goal in nature conservation is to maintain the biological diversity in the current state. The goal is reached by following these principles:

- forest management is improved, respecting the role of forest ecosystem in both local and global processes – attracting and stabilizing the circulation of carbon dioxide, protecting the streams and reservoirs of water, soils and landscape;
- the capacity of forests resource utilization is regulated at the national level, considering productivity of forest ecosystems, ability of regeneration and other important elements of forest structure;
- the influence of forest management on environment is evaluated;
- the scientifically based system of protected areas that ensures maintenance of ecosystem, species and genetic resources of forests is improved;
- the maintenance of forest ecosystem and diversity of species is ensured;
- the forest monitoring is managed;
- the methods of forest management should imitate natural processes, therefore making ecosystems more similar to their natural structure and protecting elements that maintain biological diversity;
- government has rights to set limits to forest management or other actions taken, that threaten important natural assets and respecting of ecological principles.

The Forest Law (Latvijas Republikas Saeima, 2000) is the central law of the forest sector of Latvia, stating the following goals:

- to promote economically, ecologically and socially sustainable management and utilization of forests by ensuring equal rights to all owners and legal possessors of forest, ownership privacy, independence in economic actions and equal duties;
- to regulate terms of management.

The Forest Law also determines that terms of management of protected natural areas, micro reserves and protection zones are defined by other regulations. The Cabinet of Ministers defines terms of evaluation of a sustainable forest management by meeting criteria and indicators of Pan-Europe.

Following the definitions of this Law, the responsibility of a forest owner or legal possessor is to regenerate forest stand after felling or effect from other factors as well as to ensure tending of forest stand.

Among other regulations, the Regulation on Determination Criteria of Compensation and Calculation of Deforestation should be mentioned. This Regulation defines a procedure of calculation and compensation and criteria for negative effect caused by deforestation. It defines that the compensation to the government should be paid if the land that is registered with National Real Estate Cadaster information system as the forest area deforested. The compensation should be paid for:

- decrease of carbon dioxide attraction potential;
- reduction of biological diversity;
- decrease of quality of the environmental and natural resource protection zones and sanitary protection zone functions.

Forest-based Sector Development Guidelines (Zemkopības ministrija, 2006) are medium-term policy planning document. Guidelines consist of the forest-based sector development medium-term (2014-2020) strategic goals, guidelines of policy development, directions of actions to achieve these goals, problems hindering achievement of these goals, and results in policies. Guidelines were developed by working group created by the Ministry of Agriculture in cooperation with the Ministry of Finance, the Ministry of Environmental Protection and Regional Development, and different forest sector stakeholders.

Forest-based Sector Development Guidelines are the main document of growth and development of Latvian forestry sector. The development solutions included in this document give fundamental investment in achieving goals of other planning documents.

Following the goals of "Europe 2020: A strategy for smart, sustainable and inclusive growth", Forest-based Sector Guidelines give important investment to achievement. For example, initiative "Resource efficient Europe" – to help to decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernize our transport sector and promote energy efficiency.

The goal of Commission's strategy and action plan "Innovating for Sustainable Growth: a Bioeconomy for Europe" is a more innovative and low-emission economy, reconciling demands for sustainable agriculture and fisheries, food security, and the sustainable use of renewable biological resources for industrial purposes, while ensuring biodiversity and environmental protection. It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries. Each euro invested in EU-funded bioeconomy research and innovation is estimated to trigger €10 of value added in bioeconomy sectors by 2025. The Strategy has three main pillars:

- investment in research, innovation and skills for the bioeconomy. This should include EU funding, national funding, private investment and enhancing synergies with other policy initiatives;
- development of markets and competitiveness in bioeconomy sectors by a sustainable intensification of primary production, conversion of waste streams into value-added products, as well as mutual learning mechanisms for improved production and resource efficiency, creating jobs and growth;
- reinforced policy coordination and stakeholder engagement.

In **Guidelines of Land Policies 2008-2014** the goal is to ensure sustainable use of land as unique natural resource. By following this goal it is foreseen that by 2030 the indicators of land use will be:

- agricultural lands – 35%;

- forest lands – 56%;
- lands for construction purposes – 7%;
- other lands (shrubs, swamps, under water) – 12%;
- agricultural lands that are not used – 1%.

The Guidelines of Environmental Policies 2014-2020 set general goal – to ensure ability of living in clean and settled environment, by fulfilling actions moving towards sustainable development, maintaining the quality of environment and biological diversity, ensuring sustainable use of natural resources, participation of society in making decisions and information of environmental state. Guidelines anticipate:

- to ensure good environmental management at all levels, as well as communication that is based on a complete and expanded environmental information. Encourage wide involvement of society in solving the environmental questions;
- to ensure balance between protection of nature and economic interests;
- to ensure Latvia's input in the reduction of global climate change by balancing environmental, social and economic interests including goal of carbon dioxide attraction in forest sector;
- to ensure timely and comprehensive compilation and analysis of environmental and climate change data and information. This helps setting the policy goals and adequate measures to improve environmental situation and to react on climate change in time, as well as evaluating usefulness and efficiency of current actions and invested funding including forest monitoring.

Rural Development Programme 2014-2020 sets three long-term strategic rural development policy goals:

- competitiveness of agriculture;
- sustainable management of natural resources and climate policies;
- balanced territorial development in rural areas.

To achieve goals of rural development policies, common priorities of the European Union have been set:

- to encourage knowledge transfer and innovation in agriculture, forestry and rural areas;
- to improve competitiveness of all types of agriculture and to strengthen vitality of farms;
- to encourage organization of food movement and risk management in agriculture;
- to restore, preserve and improve ecosystems depending on agriculture and forestry;
- to encourage effective usage of resources and economics resistant to climate change with low emission level of carbon dioxide in agricultural, food and forestry sectors;
- to encourage social inclusion, decrease of poverty and economic development in rural areas.

EU policies relating to LULUCF sector (directly/indirectly)

Latvia as all Member States has introduced a substantial amount of legislation to protect, conserve and enhance ecosystems and their services. A wide range of European policies affect and benefit from natural capital. These include the Common Agricultural Policy, Common Fisheries Policy, cohesion policy, and rural development policies[7].

Table 24: Policies and implementation strategies

Topic	Related directives[8]	Overarching strategies
Biodiversity	Birds Directive Habitats Directive Invasive Alien Species Regulation	Biodiversity Strategy to 2020
Land and soil		Thematic Strategy on Soil Roadmap to a Resource Efficient Europe
Water	Water Framework Directive Flood Risk Directive Urban Waste Water Treatment Directive Priority Substances Directive Drinking Water Directive Groundwater Directive Nitrates Directive	Blueprint to Safeguard Europe's Water Resources
Air	Ambient Air Quality Directive National Emission Ceilings Directive	Thematic Strategy on air pollution
Climate	Renewable Energy Directive Biomass Directive Energy Efficiency Directive	EU Strategy on adaption to climate change 2020 Climate and energy package

Energy policy

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources sets target to 2020 for share of energy from renewable sources in gross final consumption of energy – 40%. Latvia is gradually approaching this target. The share of energy from renewable sources in 2008 was 29.81%, in 2010 – 32.49%, in 2012 – 35.78% and small increase of this indicator is expected in 2015.

In the Informative Report "Latvian Energetic Long-term Strategy 2030 – Competitive Energy for Society" (Ekonomikas ministrija, 2011) there is a non-binding goal – to reach the share of renewable energy as 50 % of the gross final consumption in 2030. The main goal of the Strategy will be reached if influence of energy sector in Latvian economy is positive. The safety and sustainability of power supply are subordinated but not less important goals.

The share of wood fuel in Latvian energy resources traditionally has been significant because of the availability. Therefore wood fuel is the most popular renewable energy resource in Latvia. For many years wood fuel forms one quarter of the total consumption of energy resources (2010 – 25.6%, 2011 and 2012 – 25.4%, 2013 – 28.0%) while the share among renewable energy resources in 2013 was 78.0%.

Bioenergy demand is expected to rise. In Latvia, the biggest share of woody biomass is used in households, followed by industrial consumption and district heating and combined heat and

[7] Europe's environment 2015: Future prosperity depends on bolder steps in policy, knowledge, investments and innovation.

[8] Report from the Commission – 31st Annual Report on monitoring the application of EU law (Brussels, 1 October 2014)

power (CHP). According to the national study[9] the use of bioenergy in Latvia is expected to rise rather significantly in near future comparing to the year 2010. The highest rise is foreseen in industrial consumption (+102 %) and in district heating and CHP (+67 %).

According to existing regulations, about a half of growing stock can be extracted in final felling until 2020, because forests are reaching maturity age, but it is considered that only about 30 % of available volume will be harvested to secure the same amount of deliveries after 2020. Besides, a rapid increase of average age of forests, especially in deciduous stands with a considerably shorter rotation period, will lead to increase of mortality rate and emissions due to decomposition of dead wood.

In Latvia, the national forest policy lays down a solid and constant basis for a sustainable forest management. Harvesting amount is determined rather by market demand that differs from one year to another, while the environmental integrity is always ensured. Also in the future (including the KP 2nd commitment period) no change in the national forest policy is foreseen. However, changes will trigger other policies – the high impact for Latvia particularly is foreseen in the context of the EU's renewable energy targets under the Europe 2020 Strategy.

Latvia is an exporter of forest products and provides a sustainable bioenergy for Europe. With 52 % of forest coverage, Latvia is the 4th densely forested country in the EU. Due to the ambitious EU's renewable energy targets the rise of bioenergy demand (wood) from the EU Member States is expected. Sustainably managed forest resources of Latvia will be used in many EU countries instead of fossil fuels and thus contributing to meet the renewable energy targets under the Europe 2020 Strategy. Figure 17 clearly demonstrates this process of increasing export of biomass. However, it is likely that for Latvia the rise of harvesting will translate in the Forest Management Reference Level (FMRL) debits (Figure 18).

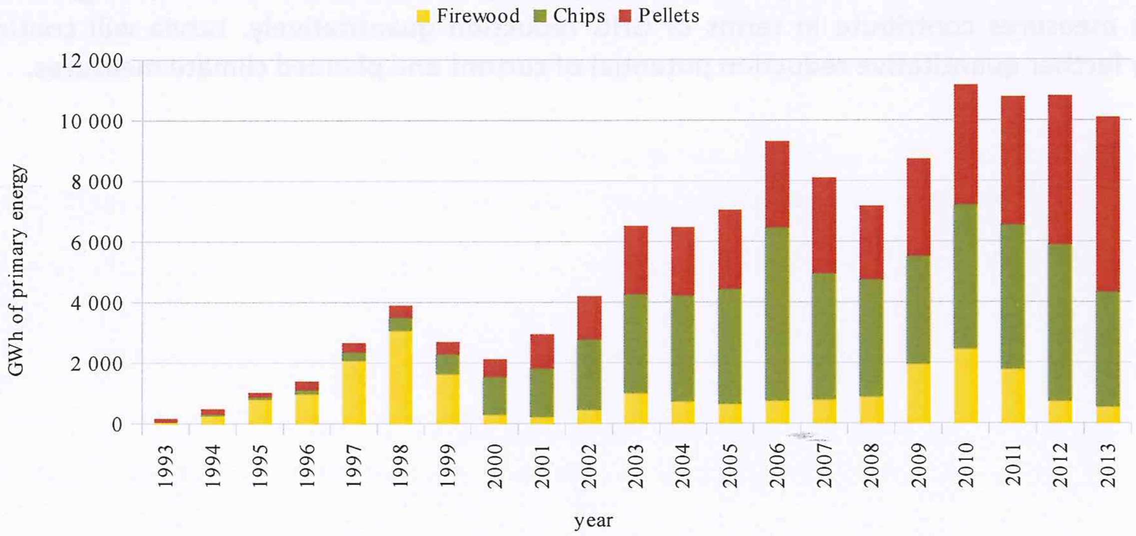

Figure 17: Solid biofuel export from Latvia

9 Koksnes biomasas izmantošanas enerģijas ieguvē monitorings (Monitoring of utilization of woody biomass in energy production), SIA „Meža un koksnes produktu pētniecības un attīstības institūts. Available from: https://www.zm.gov.lv/public/ck/files/ZM/mezhi/MAF/Koksnes%20biomasas%20izmantosana%20energija%20ieguve%20monitorings_MEKA.pdf

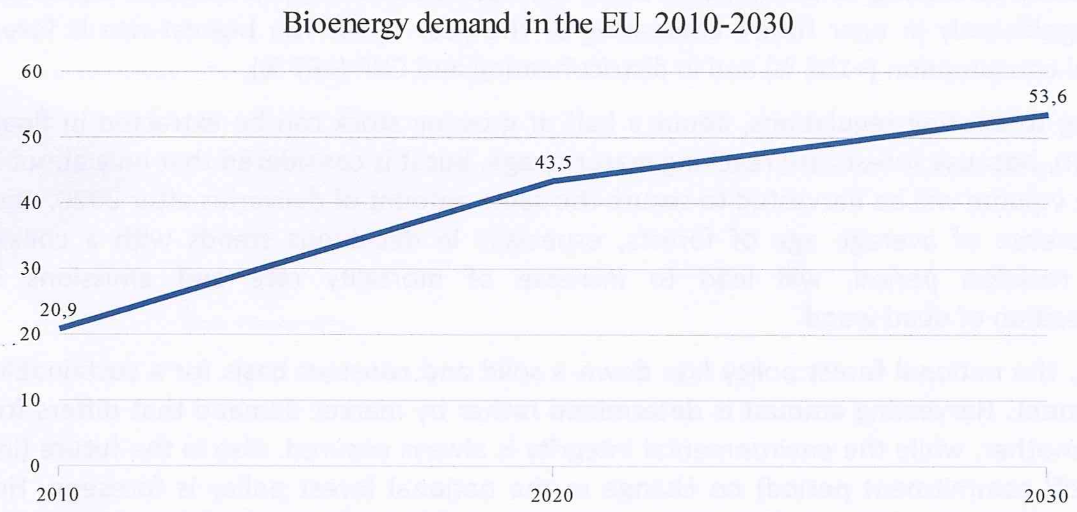

Figure 18: Bioenergy demand in the EU 2010-2030 (Mantau *et al.*, 2010)

Forest living biomass will continue to be a sink of CO_2 removals in the future; however, the accumulation of carbon in all pools will continue to reduce. **The projections of the GHG emission cannot predict potential impact of relevant policies in other European countries, like energy policy,** which can have a significant impact on CO_2 emissions due to forest and cropland management and land use changes. Similarly, potential impact from application of new calculation methods is not fully evaluated and might affect results of the projections, especially drainage and organic soils related emissions.

In the process of developing this study a number of different possible climate friendly measures have been identified. **However, there is not a clear, science-based understanding, how all of those measures contribute in terms of GHG reduction quantitatively. Latvia will continue to study further quantitative reduction potential of current and planned climate measures.**

Timetables

Indicative timetable for the adoption and implementation of the measures referred to in chapter List of measures is provided in Table 25.

Table 25: Timetable for implementation of the climate change mitigation targeted measures in LULUCF sector.

No.	Measure	Source	Adoption	Implementation
1.	Development and adaptation of drainage systems in cropland	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
2.	Support to introduction and promotion of integrated horticulture	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
3.	Greening activities	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
4.	Production of legumes	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
5.	Support to stubble field in winter period	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
6.	Development and adaptation of drainage systems in forest land	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
7.	Afforestation and improvement of naturally afforested areas	Rural Development Programme 2014-2020	2015	continuously in 2016-2020
8.	Improvement of ecological value and sustainability of forest ecosystems	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
9.	Regeneration of forest stands after natural disasters	Rural Development Programme 2014-2020	2015	continuously in 2015-2020
10.	Preventive forest fire measures	Rural Development Programme 2014-2020	2015	continuously in 2015-2020

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