INFORMATION ON LULUCF ACTIONS IN LATVIA

Progress report under EU Decision 529/2013/EU Article 10

RIGA 2017

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
MoA – 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 and in Article 3(2) - cropland management and grazing land management, for which Member States shall prepare and maintain annual accounts. 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).

This progress report provide the updates of information and developments concerning activities which were included in previous information on LULUCF actions as well as describe the process of the implementation of LULUCF actions in Latvia, which are due by 31 December 2016. The Progress report was compiled by Latvian State Forest Research Institute “Silava” in cooperation with the Ministry of Agriculture of the Republic of Latvia and the Ministry of Environmental Protection and Regional Development of the Republic of Latvia.

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Executive summary

The information on LULUCF actions is prepared by Latvian State Forest Research Institute "Silava" (LSFRI Silava) in cooperation with the Ministry of Agriculture of the Republic of Latvia (MoA) and the Ministry of Environmental Protection and Regional Development of the Republic of Latvia (MEPRD). Other institutions were involved in order to provide complete and accurate data for the submission of the LULUCF Progress report to the European Commission.

Environmental and biodiversity protection, sectoral development and sustainable management of natural resources in Latvia is regulated 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. In Latvia, national forest policy lays down comprehensive basis for sustainable forest management. Harvesting amount is determined by age structure of forests and market demand of wood products, while environmental integrity is always ensured. In the future (including the KP 2^{nd} CP) no significant changes in national forest policy affecting the harvest rates 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 of the proposed measures affect greenhouse gas (GHG) emission reduction is not fully quantified using nationally verified methods.**

The progress report presents updated information of LULUCF measures and describes the process of their implementation, additionally updated information on national circumstances and GHG projections. Actions are **based on the measures of the Latvian Rural Development Programme 2014-2020 (hereinafter referred to as RDP 2014-2020)**[1].

Latvia's RDP 2014-2020 is approved by the European Commission on 13 February 2015. **The climate change mitigation measures with quantitative impact assessment methods which are based on guidelines of Intergovernmental Panel on Climate Change (IPCC) or national estimates** are described in the following sections, including measures in cropland management and forest management.

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

Enhanced communication

MEPRD is the responsible ministry for the submission of the Progress Report to the European Commission. MoA is the responsible sectoral ministry for LULUCF sector. The report was prepared by LSFRI Silava in cooperation with other public, research 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 MEPRD, Rural Support Service (RSS), State Ltd. Latvian Environment, Geology and Meteorology Centre (LEGMC), Latvia University of Agriculture (LUA). The LSFRI Silava and MoA have main responsibility to provide historical trends and future projections of greenhouse gas emissions and removals in LULUCF sector.

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

In the process of initial communication with the stakeholders, a number of different climate change mitigation measures have been identified and underlined. However, there is no clear, science-based substantiation of quantitative contribution of certain measures to GHG emissions reduction. 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.

During 2015-2016, LSFRI Silava implemented the project "Development of appropriate methodological solutions and improvement of inventory system of GHG emissions and CO_2 removals due to cropland and grazing land management". Within the project, proposals for the establishment of the institutional system were prepared to provide estimates of emissions and removals arising from cropland and grassland management in accordance with Article 3(2) of EU Decision 529/2013/EU.

Overview of national circumstances

The total area of Latvia is 6.46 million ha including 6.22 million ha of land area. According to the NFI 52% of the land area is forest (excluding forest infrastructure like road networks and seed orchards), 37% is farmland (including 26% of cropland and 11% of grassland), 7% are wetlands, including water bodies, and 4% are settlements. The population of Latvia in 2015 was close to 2 million people. The total nominal GDP of the country in 2015 was 24.4 billion EUR (Central statistical bureau, 2016).

In order to meet the future demands of a growing population globally, it may be necessary to increase the area of cropland as well as efficiency of production in order to deliver 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 cropland2. 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 EU member states, because there is still considerable amount of temporarily extensively cultivated cropland. Most of this land can be returned to crop production (Figure 1).

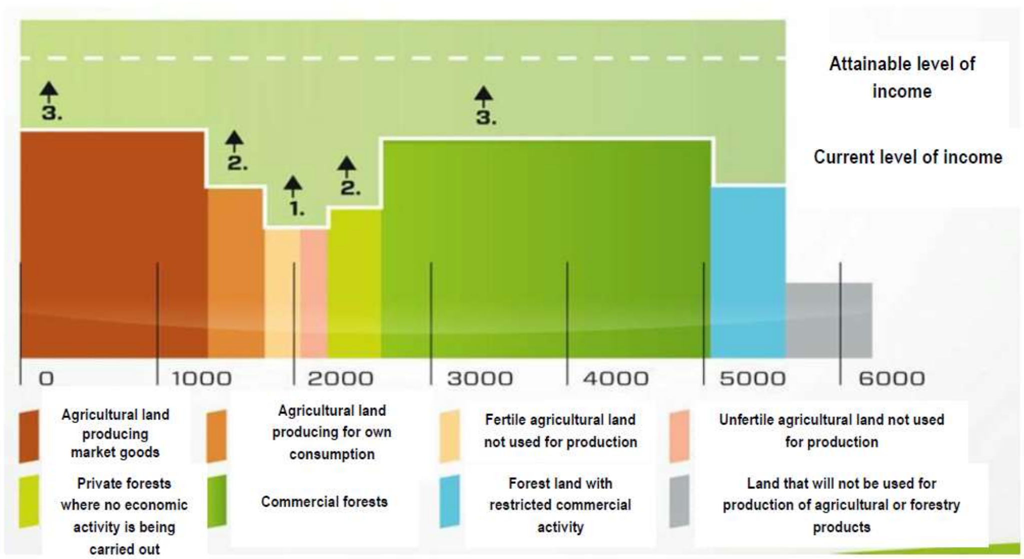

Figure 1: Land analysis according to classification by the MoA

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 share of managed agricultural land has to be 95% from the total land area that can be used for agricultural purposes. Since joining the EU, there is a steady rise in utilised area of farmlands (Figure 2).

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

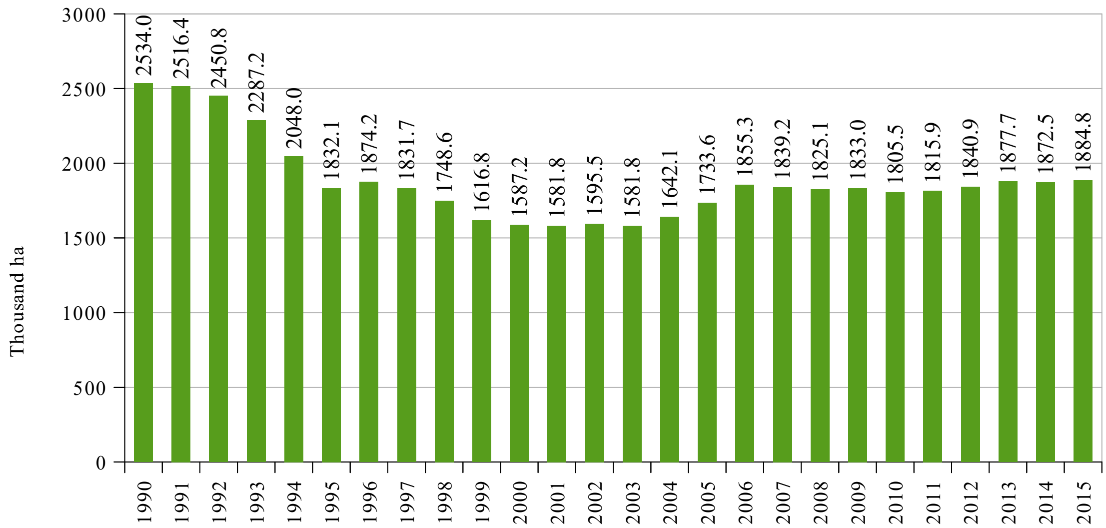

Figure 2: Utilised area of farmlands[3]

Since 2009, the information about land use is provided in the NFI. Information about grassland, cropland, wetlands and other lands provided by the State Land Service (SLS) 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 (NDVI) in the NFI plots (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 and linear extrapolation of the recently occurred land use changes. 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	3 124.22	1 842.24	798.24	238.82	448.35	5.44
1991	6 457.30	3 128.56	1 837.27	798.26	239.41	448.35	5.44
1992	6 457.30	3 135.28	1 833.98	794.24	240.01	448.35	5.44
1993	6 457.30	3 143.49	1 828.93	790.49	240.60	448.35	5.44
1994	6 457.30	3 149.67	1 823.50	789.15	241.19	448.35	5.44
1995	6 457.30	3 160.27	1 817.85	783.61	241.78	448.35	5.44
1996	6 457.30	3 173.39	1 810.36	777.51	242.26	448.35	5.44
1997	6 457.30	3 185.24	1 802.95	772.60	242.73	448.35	5.44
1998	6 457.30	3 197.95	1 797.12	765.24	243.20	448.35	5.44
1999	6 457.30	3 209.19	1 789.13	761.52	243.67	448.35	5.44
2000	6 457.30	3 222.13	1 782.39	754.84	244.15	448.35	5.44
2001	6 457.30	3 236.66	1 773.20	748.62	245.04	448.35	5.44
2002	6 457.30	3 248.73	1 766.53	742.32	245.92	448.35	5.44
2003	6 457.30	3 257.90	1 759.41	739.39	246.81	448.35	5.44

3 EUROSTST, last update 7 November 2016.

Year	Total area	Forest land	Cropland	Grassland	Settlements	Wetland	Other land
2004	6 457.30	3 270.95	1 750.97	733.90	247.70	448.35	5.44
2005	6 457.30	3 281.85	1 742.26	730.82	248.59	448.35	5.44
2006	6 457.30	3 289.65	1 733.30	731.09	249.48	448.35	5.44
2007	6 457.30	3 297.27	1 724.07	731.81	250.36	448.35	5.44
2008	6 457.30	3 307.06	1 714.58	730.62	251.25	448.35	5.44
2009	6 457.30	3 305.78	1 714.80	731.72	251.66	447.90	5.44
2010	6 457.30	3 304.50	1 715.02	732.82	252.08	447.44	5.44
2011	6 457.30	3 303.22	1 715.24	733.93	252.49	446.99	5.44
2012	6 457.30	3 301.94	1 715.45	735.03	252.90	446.54	5.44
2013	6 457.30	3 300.66	1 715.67	736.13	253.32	446.09	5.44
2014	6 457.30	3 299.38	1 715.89	737.23	253.73	445.63	5.44

Most of the changes occur due to the conversion of grassland to forest land, forest land to settlements, wetlands or cropland and cropland to grassland.

According to its hydrothermal properties, Latvian soils are divided into three classes: Automorphic, Semihydromorphic and Hydromorphic. Automorphic soils develop in well drained 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. Hydromorphic and organics rich Semihydromorphic soils are treated as Histosols in calculation of GHG emissions.

In forest lands the key challenges in reduction of the GHG emissions is more efficient regeneration of forests to maintain high increment rates, management of organic soils and harmonization of age of forest stands to avoid accumulation of over-mature forests contributing to increasing GHG emissions due to decomposition of dead wood and reduction of increment in living biomass. Similarly, efficiency of conversion of roundwood into harvested wood products should be increased.

The most challenging task in cropland and grassland management is to secure increase and maintenance of carbon stock 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 have 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.

Key carbon pools and sources in LULUCF sector

The most significant key source/pool category according to the level and trend assessment is **Forest land remaining forest land**. 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.** However several recalculations are proposed in the future submissions of the National GHG inventory, which might lead to considerable changes in the list of the key categories. For instance, improvement of accounting of emissions from organic soils by implementation of nationally verified emission factors in 2019. Complete listing of the key categories of the GHG emissions in LULUCF sector according to the GHG inventory report (1990-2014) is provided in Table 2.

Table 2: Key categories of the GHG emissions

No	Key categories of emissions and removals	GHG
1.	4.A.1 Forest Land remaining Forest Land – Carbon stock change, dead wood	CO_2
2.	4.A.1 Forest Land remaining Forest Land – Carbon stock change, living biomass	CO_2
3.	4.A.1 Forest land remaining forest land - Controlled burning	CO_2
4.	4.A.1 Forest Land remaining Forest Land – Drained organic soil	CO_2
5.	4.A.1 Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CO_2
6.	4.A.1 Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	N_2O
7.	4.A.1 Forest land, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4
8.	4.A.2 Land converted to Forest Land – Carbon stock change, grassland converted to forest land	CO_2
9.	4.A.2 Land Converted to Forest Land – grassland converted to forest land, carbon stock change, dead wood	CO_2
10.	4.B. Cropland remaining cropland, Emissions and removals from drainage and rewetting and other management of organic and mineral soils	CH_4
11.	4.B.1 Cropland remaining Cropland – Drained organic soil	CO_2
12.	4.B.1 Cropland remaining Cropland – Carbon stock change – living biomass	CO_2
13.	4.B.1 Land converted to Cropland – Carbon stock change – dead organic matter	CO_2
14.	4.B.2 Land converted to Cropland – Drained organic soil	CO_2
15.	4.B.2 Land converted to Cropland – Carbon stock change, forest land converted to cropland	CO_2
16.	4.B.2 Land converted to Cropland –Mineral soil	CO_2
17.	4.C.1 Grassland remaining Grassland – Drained organic soil	CO_2
18.	4.C.2 Land converted to Grassland – Drained organic soil	CO_2
19.	4.C.2 Land converted to Grassland –Mineral soil	CO_2
20.	4.D.1 Wetlands remaining Wetlands – Carbon stock change – living biomass	CO_2
21.	4.D.1 Wetlands remaining Wetlands – Carbon stock change –organic soils	CO_2
22.	4.D.1 Wetlands, Peat extraction from lands, organic soils	CO_2
23.	4.E.1 Settlements remaining Settlements – Carbon stock change – living biomass	CO_2
24.	4.E.2 Land converted to Settlements – Carbon stock change – dead organic matter	CO_2
25.	4.E.2 Land converted to Settlements – Carbon stock change – living biomass	CO_2
26.	4.E.2 Land converted to Settlements – Mineral soils	CO_2
27.	4.E.2 Land converted to Settlements – Organic soils	CO_2
28.	4. G. Harvested wood products	CO_2

Land Sector Profile

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 about 50% of Latvia's forests; the rest is managed mainly by the Joint stock Company "Latvia State Forests". Structure of ownership of the private forests is changing rapidly and consolidation of properties takes place. Considering **the age structure of Latvia's forests** and the structure of forest resources (currently nearly a third of forests with a half of the total growing stock meet the threshold values of regenerative felling and **share of mature forests is rapidly increasing**). The regeneration of forests following with temporal decrease of the annual increment is the only strategically sustainable approach in forest management, in spite it leads to short term reduction of carbon stock in forest. Most of overgrown forests are of those owned by private persons or they are poorly economically accessible – felling and regeneration costs might be higher than a 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** since 1990 and needs investments for reconstruction and expansion of the networks. 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 without reduction of the soil carbon stock if the intensified management approaches including fertilizations applied. According to the NFI 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. Biofuel production from forest biomass is growing industry in Latvia – production of wood pellets is nearly doubled within 6 years, reaching more than 1 million tonnes annually. **Local bioenergy market is also developing,** securing outputs for low grade biomass like harvesting residues and below ground biomass, however these resources are still underutilized due to lack of demand. 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 continue to 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 at a removals side. The decrease of felling rates might 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 expanding mortality, lost economic potential of forests and distribution of certain forest pests and diseases in mature stands resulting in expanding of natural disturbances. Nearly one third of forests in Latvia have exceeded economic maturity age and 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, contributes to bioeconomy development and to implementation of the renewable energy policy targets. Increase of felling rates will result in continuous growth of Harvested Wood Products (HWP) pool and deliveries of forest biofuel. Using renewable energy sources like wood instead of 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. Due to insufficient use of support to afforestation and improvement of 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 is not fully utilized. For instance, there are lots of non-productive grey alder and aspen stands. It is more beneficial from the climate change mitigation perspective to use these areas for growing economically 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. 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 2015 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)[4]. As compared with the EU average, Latvian agriculture is partially extensive and still in a developing phase – low livestock density and relatively high GHG emissions per produced unit.

In Latvia cultivation of organic soils (cropland and grassland) formed the substantial part of total emissions. Share of organic soils under cultivated area (particularly in cropland and grassland) in Latvia according to study results is 5.18% of the total area, which is considerable quantity of emissions with a significant abatement potential if land use is changed to forest land, wetland or grassland. However knowledge about impact of different management practices on carbon stock in organic soils is limited and controversial.

Understanding importance and climate change mitigation potential of soil organic carbon, Latvia has joined to “4 per 1000 “initiative and considers possibilities to evolve national soil organic carbon maintenance and monitoring system.

The area of cropland in Latvia has decreased by 8% since 1990.Arable lands were abandoned due to economy transition and 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. In 2006-2010 agriculture suffered from economic crisis, just like other sectors, resulting in temporal reduction of production. In recent years situation is rapidly changing due to overall increase of economic activity as well as support provided by the Rural Development Programme and national financial instruments. As from 2004, the cropland area used for crop production has been increasing again due to increased investments and subsidies from the European Union 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 earlier 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. Latvia has elaborated activity data and GHG projections for agriculture until 2050 and significant development in agricultural production is projected to achieve the EU average agricultural output. Cropland area projections in LULUCF reflects projected growth in agriculture area utilized for crop production will increase by 5% in 2030 in comparison to 2015, Figure 3). **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).**

4 According to Central Statistical Bureau, 2014.

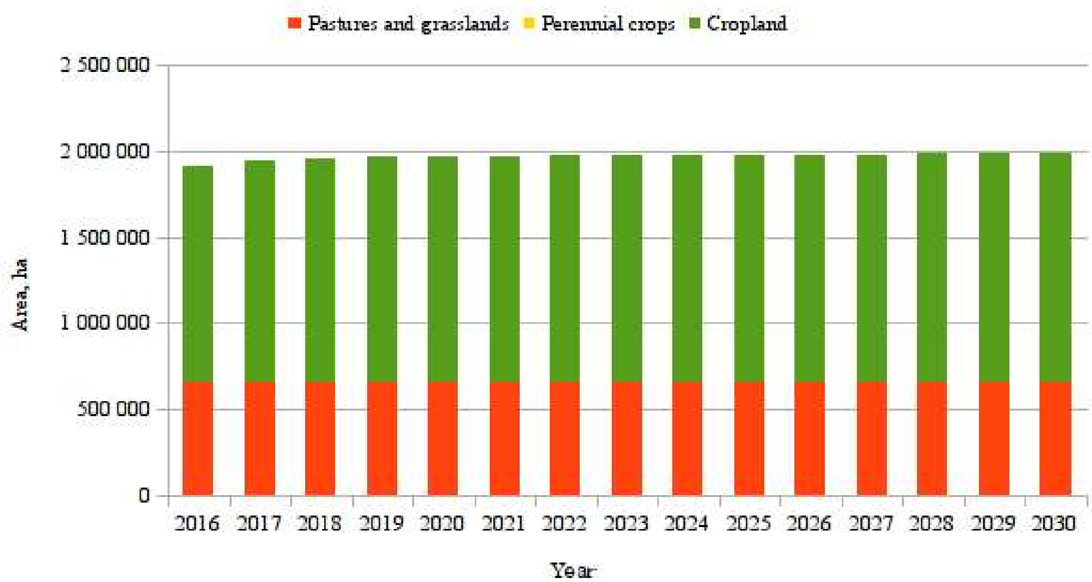

Figure 3: Projections of area of farmlands

Net CO_2 eq. emissions from cropland decreased from 1990 to 2014 by 15 % due to reduction of area of cropland, as well as due to reduced impact of deforestation to cropland taking place in early 1990s; however, the NFI data and production statistics highlight potential increase of the GHG emissions in cropland due to land use changes from grassland in future because of 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, 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 the 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. Opposite process causing N_2O and CO_2 emissions took place due to conversion of forest land (abandoned and naturally afforested farmlands, in the most cases) 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 to cropland is not realistic scenario due to economic barriers (investments in drainage systems and additional meteorological threats).

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.

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 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.

Grassland is a net source of the GHG emissions due to CO_2 emissions from organic soils. 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 2014, the area of grassland decreased by 8 % as compared to 1990 due to natural afforestation. There is tendency of decrease of the grassland area also due to conversion 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 or to reduce GHG emissions from grassland. However, 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 GHG emission reduction due to lack of research data, but this activity will have considerable potential to reduce GHG emissions, both in forest land and grassland.

Area of **wetlands** (including swamps, peatland and inland water bodies) has not changed significantly since 1990.**There is a potential to reduce GHG emissions also in peatlands**. Most of the emissions from peatland are related to production of peat products **for horticulture**. Abandoned peatlands (according to different sources about 35 000 ha, including already afforested areas) 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.

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 considerable source of methane 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 is not compensating any more GHG emissions from organic soil, particularly, those in cropland and grassland. **GHG emission projections 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 increase of harvests. Similarly, potential impact from application of new calculation methods is not fully evaluated and might affect results of the projections, especially soil related emissions.

Past emissions and removals

Total emissions of aggregated GHG (CO_2, CH_4 and N_2O) in LULUCF sector in 2014 were 4220 kt CO_2 equivalent (Figure 4 and Table 3). Aggregated net removals of the GHG reduced by 150 % in 2014 compared to 1990 (Latvia's National Inventory Report 1990-2014). Decrease of CO_2 removals in living biomass in forest land is associated with increase of the harvesting rate, increase of mortality and reduction of increment. Settlements are the source of the GHG emissions mainly due to land use changes – conversion of forest land. The largest source of CO_2 emissions in cropland and grassland is organic soil.

The most important improvements in calculation of past GHG emissions and CO_2 removals are implementation of country specific wood density values, carbon stock in different fractions of biomass, biomass expansion factors, as well as recalculation of losses due to commercial harvesting and natural mortality in forests.

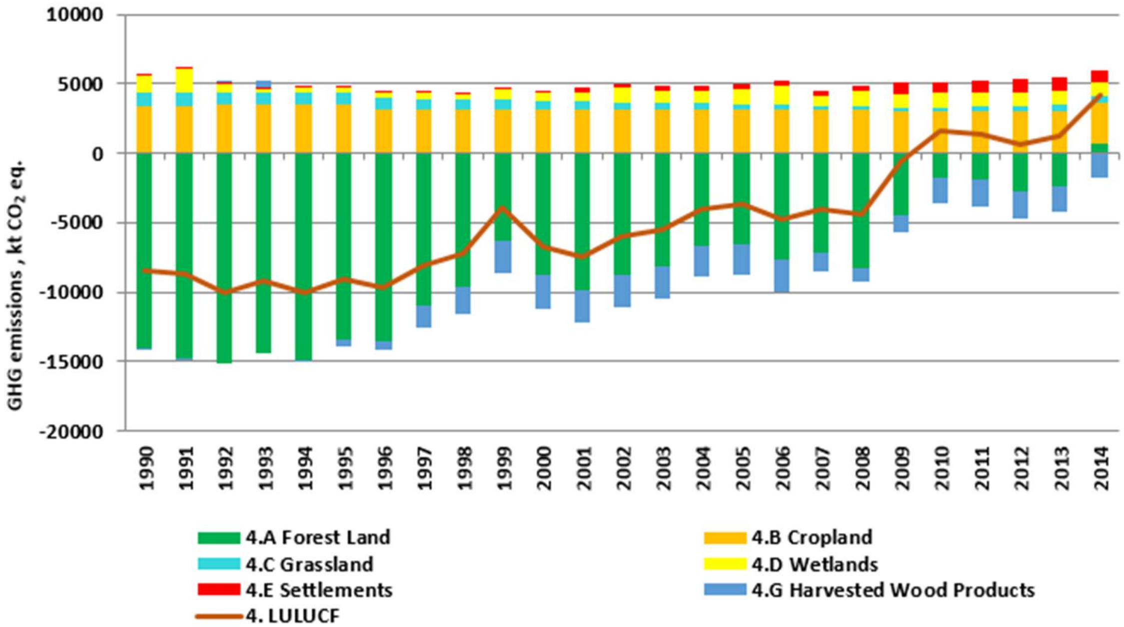

Figure 4: Net emissions in LULUCF sector

Table 3: Summary of net emissions and removals in the LULUCF sector by land-use category and harvested wood products[5]

Category	1990	1995	2000	2005	2010	2014
4. LULUCF	-8421.63	-9037.92	-6695.77	-3728.88	1574.79	4220.14
4.A Forest Land	-14006.83	-13497.13	-8816.64	-6531.41	-1773.97	745.83
living biomass	-19117.40	-17072.79	-10849.36	-8319.10	-4095.37	-870.27
dead wood	75.70	-1554.22	-3368.18	-3074.65	-2740.66	-3876.24
litter	-1.38	-15.78	-36.01	-56.07	-67.25	-71.84
organic soils	4749.10	4747.47	4772.36	4775.73	5038.67	5455.25
biomass burning	287.16	398.19	664.53	142.69	90.64	108.93
4.B Cropland	3419.36	3535.54	3196.05	3150.32	3030.20	2890.39
living biomass	367.23	429.56	191.89	179.06	106.08	12.89
dead organic matter	145.69	152.04	70.11	68.59	42.93	7.40
mineral soils	6.94	41.61	55.91	68.35	73.97	54.06
organic soils	2898.92	2908.78	2873.38	2828.50	2800.92	2811.15
4(III) N mineralization	0.59	3.54	4.76	5.82	6.30	4.88

5 Positive figures indicate emissions, negative removals, kt CO_2 eq.

Category	1990	1995	2000	2005	2010	2014
4.C Grassland	971.46	812.71	614.31	406.34	299.99	486.87
living biomass	-19.18	-20.69	-22.19	-21.74	-49.50	-42.88
dead organic matter	-4.28	-3.62	-2.78	-1.78	-7.64	-8.56
mineral soils	0.00	-139.67	-301.88	-481.31	-603.80	-495.26
organic soils	994.82	976.60	940.74	910.80	960.46	1032.29
biomass burning	0.10	0.10	0.42	0.38	0.47	1.27
4.D Wetlands	1247.34	427.19	584.93	1120.34	1021.62	1014.57
living biomass	-65.31	-91.56	-99.60	-97.94	-181.69	-165.23
dead organic matter	-13.81	-15.69	-12.34	-8.12	-23.35	-29.47
organic soils	1326.46	534.45	696.88	1226.41	1226.66	1209.27
4.E Settlements	113.24	156.79	157.4	372.07	822.27	897.08
living biomass	67.62	78.44	57.50	177.83	420.73	372.73
dead organic matter	39.54	41.90	38.20	86.17	195.70	186.88
mineral soils	1.40	8.40	13.90	24.32	58.46	107.29
organic soils	3.77	22.59	38.53	67.49	119.84	185.61
4(III) N mineralization	0.91	5.46	9.28	16.25	27.53	44.56
4.G Harvested Wood Products	-166.36	-473.98	-2433.15	-2248.32	-1827.85	-1817.58

Forest land

From 1990 to 2013 forest land was a net sink, but in 2014 forest land was a net source due to increase of harvesting stock, decrease of the net CO_2 removals in living biomass and emissions from organic soils. Total GHG emissions from forest land, excluding harvested wood products in 2014 were 745.83 kt CO_2 eq. (Figure 5 and Table 3).

Forest land category includes emissions and removals resulting from carbon stock changes in living biomass, litter, dead wood, organic soils and emissions from drainage and rewetting of organic soils as well as biomass burning. The aggregated net GHG emissions from forest land remaining forest were 370.68 kt of CO_2 eq. in Latvia in 2014, excluding removals in harvested wood products (respectively -1817.58 kt CO_2 eq) and emissions from drainage and rewetting of organic soils (respectively 810.72 kt CO_2 eq.). The net removals from land converted to forest in 2014 were 435.57 kt CO_2 eq.

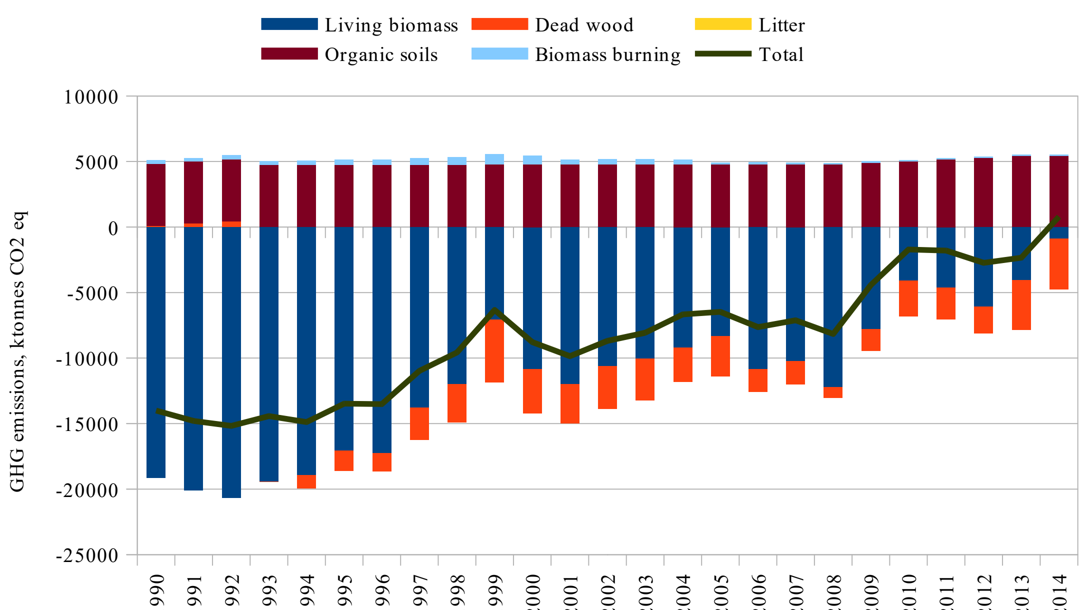

Figure 5: Structure of GHG emissions in forest lands

Cropland

GHG emissions from cropland in 2014 were 2890.39 kt CO_2 eq. (Table 3, Figure 6). Aggregated net emissions of the GHG reduced by 15 % in 2014 compared to 1990. Net aggregated emissions from cropland remaining cropland were 2589.20 kt of CO_2 in 2014 (excluding 119.05 kt of CO_2 eq. emissions from drained organic soils). Decrease of CO_2 emissions in cropland remaining cropland in period 1990-2008 is associated with land use change from cropland to grassland. The net GHG emissions from land converted to croplands in 2014 (excluding emissions from drainage of organic soils) were 182.15 kt CO_2 eq.

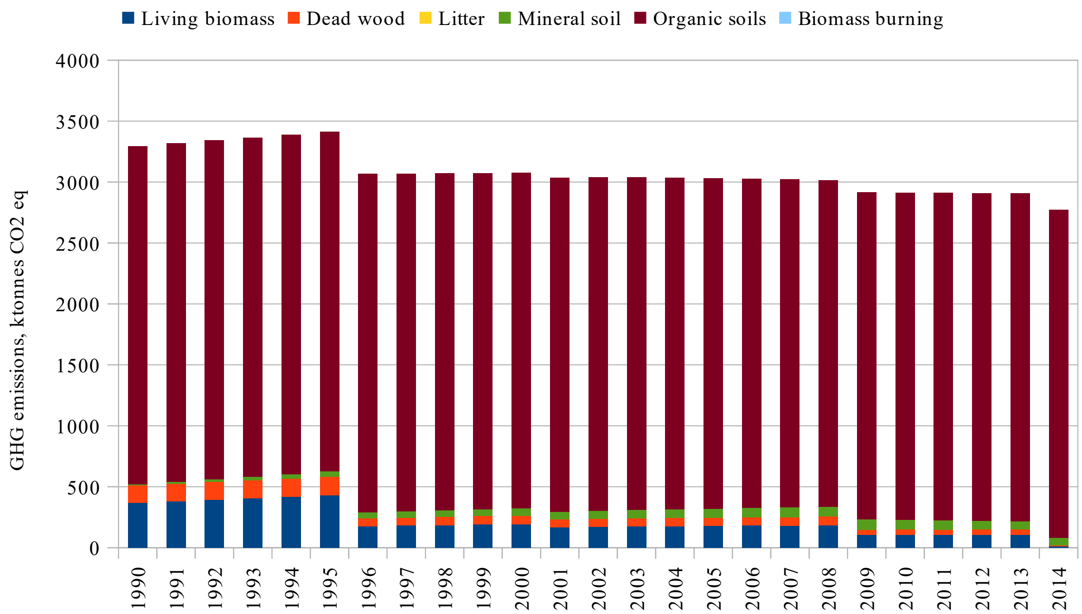

Figure 6: Summary of CO_2 emissions in cropland

There are considerable areas of extensively managed croplands. It is complicated to identify, when these lands are 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 4). The identification of transition in this case takes 10 years. After implementation of this approach area 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.

Table 4: 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*

<table>
<tr><th>First NFI 2004-2008</th><th>Second NFI 2005-2013</th><th>Third NFI 2014-2019</th><th>Fifth NFI 2020-2024</th></tr>
<tr><td rowspan="5"></td><td></td><td></td><td>No signs of ploughing – the area remains grassland</td></tr>
<tr><td rowspan="4">No signs of ploughing – the area remains grassland</td><td rowspan="2">Whole plot or sector is ploughed – the area remains grassland</td><td>Whole plot or sector is ploughed – ploughed area is marked as cropland since third NFI</td></tr>
<tr><td>No signs of ploughing – the area remains grassland</td></tr>
<tr><td rowspan="2">No signs of ploughing – the area remains grassland</td><td>Whole plot or sector is ploughed – the area remains grassland</td></tr>
<tr><td>No signs of ploughing – the area remains grassland</td></tr>
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Grassland

Grasslands consist of lands used as pastures, glades and wooded land which do not fit to forest definition, including vegetated areas on non-forest lands complying to forest definition where land use type can be easily returned to grassland by cutting grass and small trees without legal requirement of transformation of the land use, but except grassland used in forage production and extensively managed cropland reported under cropland.

Total GHG emissions from grassland in 2014 were 486.87 kt CO_2 eq. (Table 3). Aggregated net emissions reduced by 50 % in 2014 compared to 1990. Total area of grassland in Latvia in 2014 was 737.23 kha, including 590.38 kha of grassland remaining grassland.

The grassland in Latvia is a significant source of CO_2 emissions from organic soil (Figure 7). Pikes of emissions in time series are associated with burning of grass (for instance, in 2006) because of considerably large area of wildfires in those years. CO_2 removals are accounted in living and dead biomass in wooded land not fulfilling criteria of forest definition. Land converted to grassland is net source of CO_2 removals in soil. However recent findings and projection of soil carbon stock changes using Yasso model demonstrates no difference in soil carbon stock in grassland and cropland therefore this category will be recalculated after publishing of the research results.

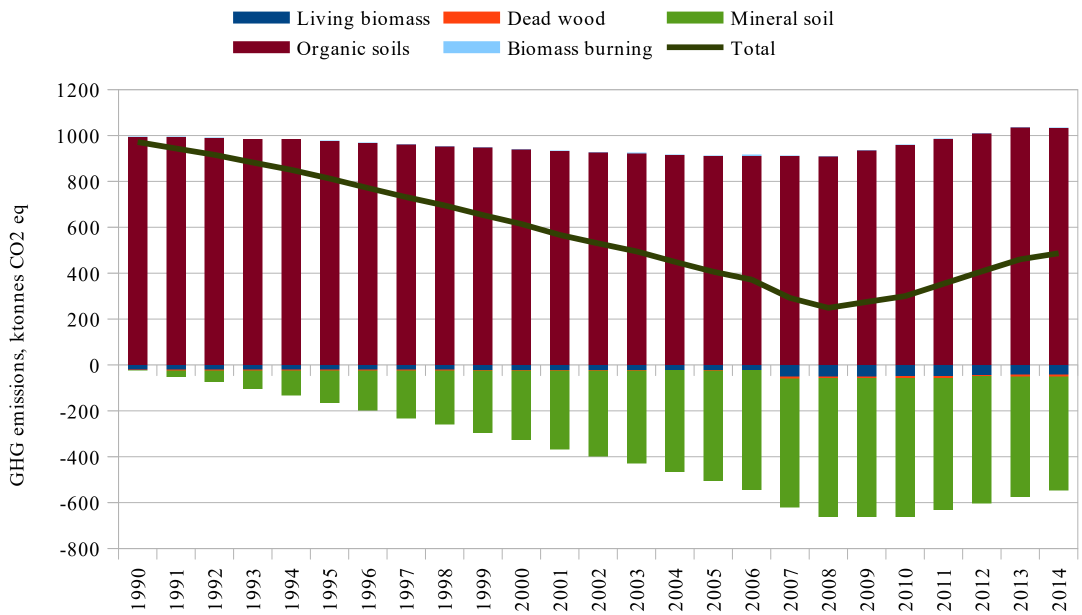

Figure 7: Summary of GHG emissions from grassland

In grasslands, the most significant source of emissions is organic soils. The figures on area of organic soils are based on municipality level summaries of soil mapping data and characterize situation before 1990 (data utilized in calculation were obtained from the 1960s to early 1980s).

Harvested Wood Products

The net removals in harvested wood (HWP) category in 2014 were 1818 kt CO_2. Aggregated net removals of the GHG increased by 1651 kt CO_2 or 993 % in 2014 compared to 1990. The net emissions during the reporting period are shown in Figure 8. Increase of removals in the HWP during the last decade is associated with increase of harvesting rate and implementation of more advanced timber processing technologies.

HWP is very important carbon pool, which has to be considered in long term forest management planning. In long term removals in HWP 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.

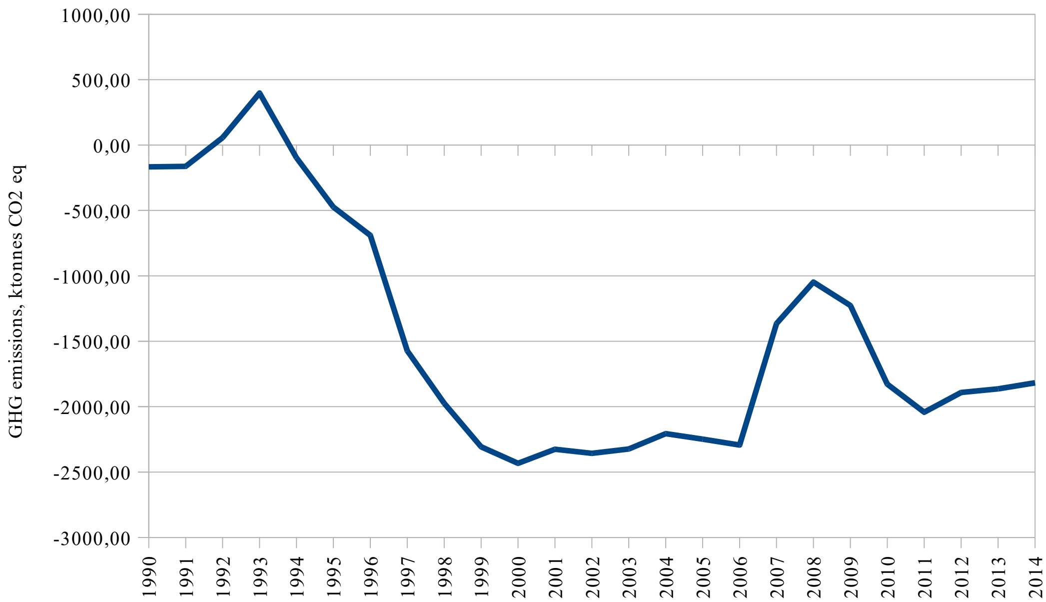

Figure 8: Net emissions from harvested wood products

Projections of GHG emissions

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 emission projection scenarios are provided. With existing measures (WEM) scenario represents projections with existing measures, which are proposed in the Rural Development Programme 2014-2020, and without measures (WOM) scenario shows projections without measures. There is no scenario with additional measures (WAM).

The net annual GHG emissions in LULUCF sector in 2020 in WOM scenario will increase to 2953 kilotons CO_2 eq. and in 2030 – they will increase to 3655 kilotons CO_2 eq. Considering that the national methodology for calculation of GHG emissions, especially those from organic soils, is still in early development stages, the provided estimates will be recalculated in future submissions. Particularly there are evidences that CO_2 emission factor for organic soil in forest land can be twice smaller than the default emission factor in the IPCC 2014. It will be implemented in the inventory as soon as the research result will be published.
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, continuous deforestation to build new settlements (mostly roads). 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 (Figure 9).

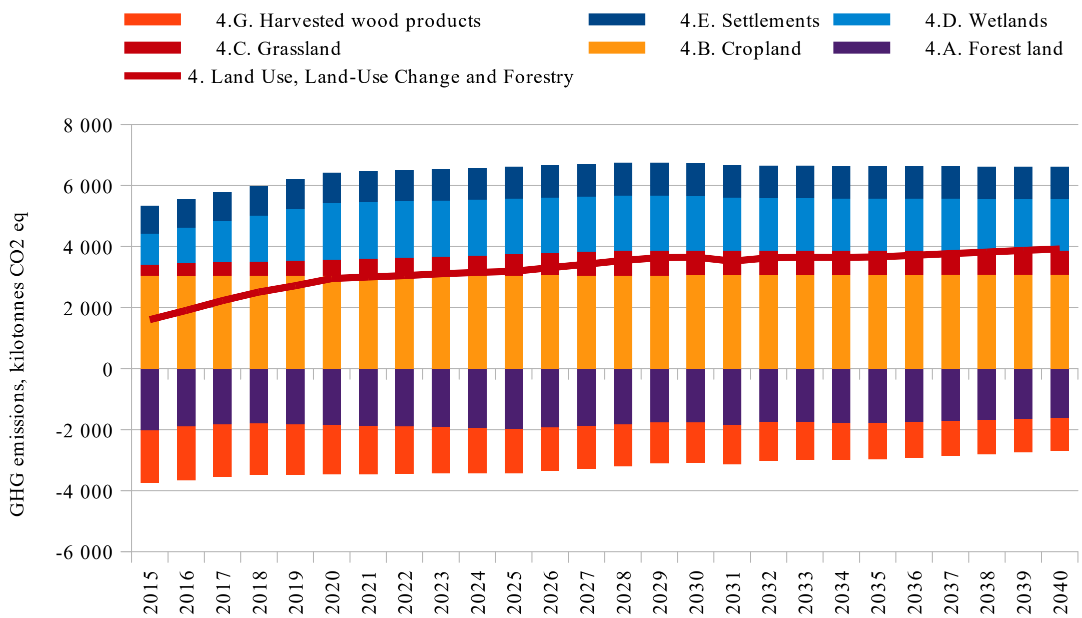

Figure 9: Net GHG emissions in LULUCF sector in WOM scenario

The estimated impact of the measures in 2015 and 2016 according to the initially proposed implementation plan are, respectively, 120 kt and 153 kt CO_2 eq. (Figure 10). Due to the fact that the implementation differs from the plan and the proposed figures represents average annual values, actual impact may differ from the plan. The proposed impact (absolute values and relative changes) of the climate change mitigation measures can reach 10% of the GHG emissions in WOM scenario until 2020 (Figure 11). The most of the impact is due to afforestation and forest thinning; however production of legumes may have considerable but uncertain effect. Field measurement based impact assessment of the new management practices is necessary to elaborate country accounting methods for this and other agriculture related measures.

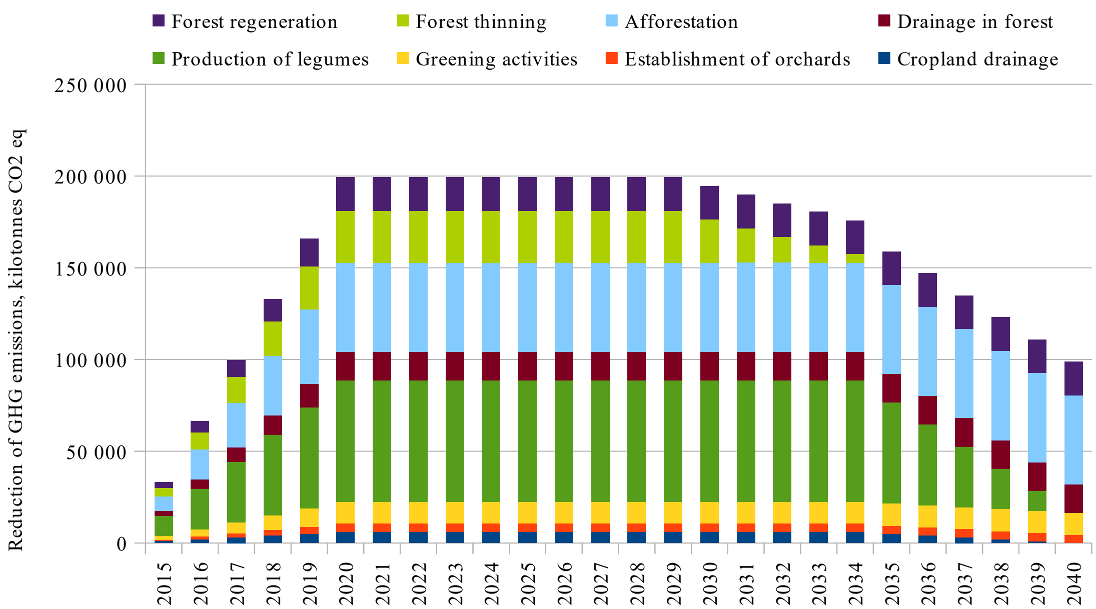

Figure 10: Impact of the measures

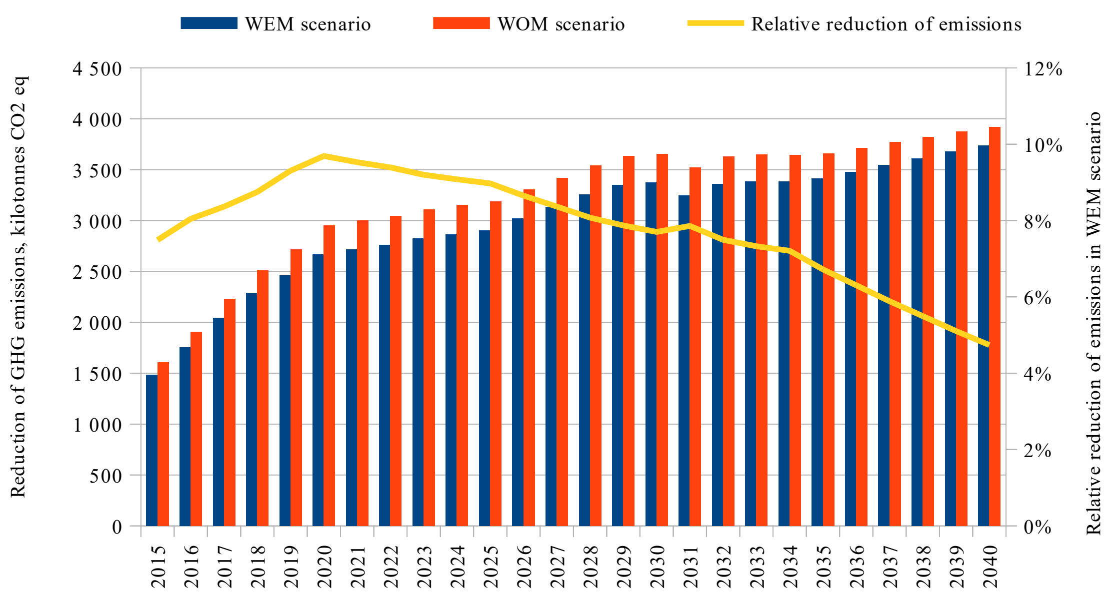

Figure 11: Comparison of WEM and WOM scenario

Identification of mitigation potential

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 currently Latvia has no nationally developed cost effective agricultural GHG mitigation strategy.

Measures in cropland

Development and adaptation of drainage systems in cropland

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.

Drainage systems in cropland in Latvia are usually established 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.

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. According to the impact evaluation of the reconstruction of the drainage ditches, it is considered, 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. 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.

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.

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 5; 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 6.

Table 5: 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 6: Summary of the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	kha	4.6
Total GHG reduction potential	tonnes CO_2eq.	122024
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	6101
	tonnes CO_2eq. $year^{-1}$ ha^{-1}	1.32

Support to introduction and promotion of integrated horticulture

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.

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 7).

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. 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 7: 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. Summary of the impact of the measure is provided in Table 8.

Table 8: Summary of the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	kha	0.5
Total GHG reduction potential	tonnes CO_2eq.	133526
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	4451

Growing of legumes

The measure applies to the use of legumes in mixture with other crops in cropland, resulting in higher inputs of organic material into soil and partial replacement of mineral fertilizers with nitrogen fixing plants. It will be implemented in intensively managed cropland with medium input of organic material (carbon stock change factor for input is equal to 1.0 (Eggleston *et al.*, 2006). According to the IPCC guidelines, after application of the measure the management system in the affected fields will be changed to "High, without manure" due to increased input of organic materials and the carbon stock change factor for input will increase to 1.11.

Summary of comparison of the both scenarios (conventional cropping system and implementation of the measure) 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. Summary of the impact of the measure is provided in Table 10.

Table 9: Summary of comparison of scenarios of growing of legumes

Parameter	Measurement unit	Conventional cropping system	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 the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	kha	50
Total GHG reduction potential	tonnes CO_2eq.	1321925
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	66096

Maintenance of biodiversity in grasslands

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 GHG emission reduction 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, GHG emissions are mitigated if management activities on organic soil are reduced. 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 IPCC 2014 Wetlands supplement CO_2 emissions from cropland on organic soil in temperate climatic zone are 28.97 tonnes CO_2 ha^{-1} annually, emissions from grassland on organic soil in temperate climatic zone are 22.37 tonnes CO_2 ha^{-1} annually, respectively, land use change from cropland to grassland on organic soil reduces 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**.

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 potentially affected area	kha	-
Total GHG reduction potential	tonnes CO_2eq.	-
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	-
	tonnes CO_2eq. $year^{-1}ha^{-1}$	0.3

Measures in forest land

Development and adaptation of drainage systems in forest land

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 (increased in short and long term prospective) and can be quantified following to existing forest management models. Impact on the non-CO_2 GHG (CH_4 and N_2O) cannot be evaluated at reasonable level on uncertainty due to lack of reliable research data. Therefore only impact on CO_2 emissions 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 GHG emission reduction effect.

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, 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 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.

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 rain falls; 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 organic soil drainage demonstrates controversial results; for instance, 51 years long monitoring of drainage impact 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). In accordance with the IPCC guidelines, soil is the source of CO_2 emissions in all forests on organic soils, CO_2 emission factor is 0.68 tonnes C ha^{-1} annually (Eggleston *et al.*, 2006). In wetlands, CO_2 emissions in rich rewetted organic soils in temperate climatic zone are 0.5 tonnes C ha^{-1} annually (Hiraishi *et al.*, 2013); respectively, difference between soil carbon stock changes in 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. In drained organic soil N_2O emissions increase by 0.60 kg N_2O-N ha^{-1} annually and in drained mineral forest soils emissions increase by 0.06 kg N_2O-N ha^{-1} annually (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 CH_4 emissions (Arnold *et al.*, 2005; 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 any more in most cases. No impact on N_2O and

CH_4emissions is used in calculation of the effect of the drainage system reconstruction in forest lands, considering high uncertainty of these estimates.

An example of two scenarios – in 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.

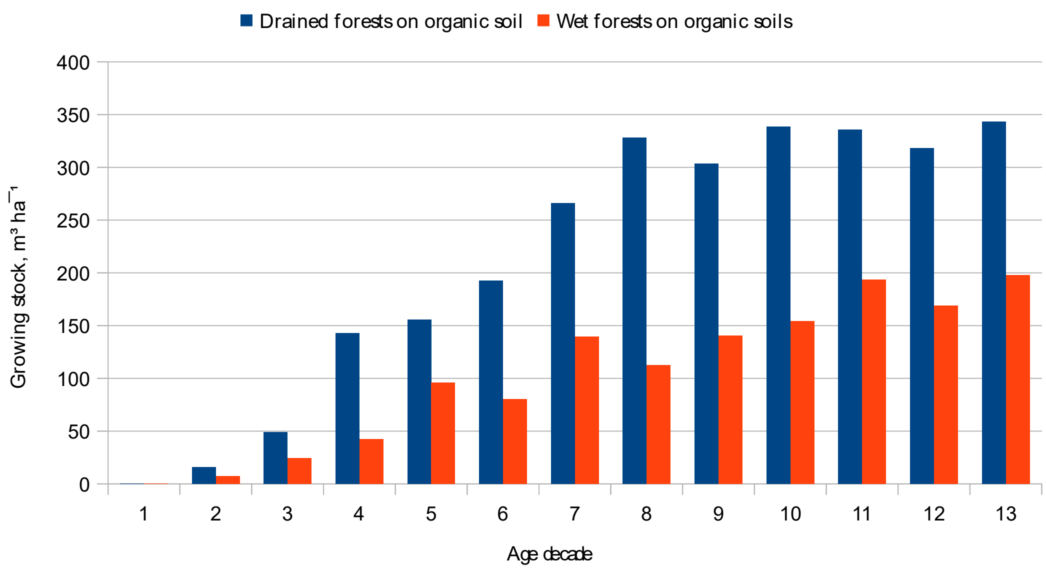

Figure 12: Growing stock in drained and naturally wet pine stands on organic soils

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, and birch, aspen). Summary of the impact resulting from the maintenance of drainage systems on growing stock is provided in Table 12. The duration of the impact is equal to an average rotation for particular species – 101 years for pine, 81 years for spruce, 71 years for birch and 51 years 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

CO_2 removals during the rotation period in case of maintenance of drainage systems reach values provided in Table 13. Additional removals can be considered in 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 the 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 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 the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	kha	12
Total GHG reduction potential	tonnes CO_2eq.	1181825
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	15612
	tonnes CO_2eq. $year^{-1}$ ha^{-1}	1.3

Afforestation and improvement of stand quality in naturally afforested areas

The scope of afforestation is economically and environmentally efficient utilization of former farmlands (mainly land with low fertility), which are not any more used for food of fodder production.

Afforestation secures accumulation of CO_2 in living and dead biomass, litter and soil. 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 years for pine, 81 – spruce, 71 – birch and 51 years 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 dead 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

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
Pine	5.29	0.47

The distribution of tree species in afforested areas in the impact calculation is adopted 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.

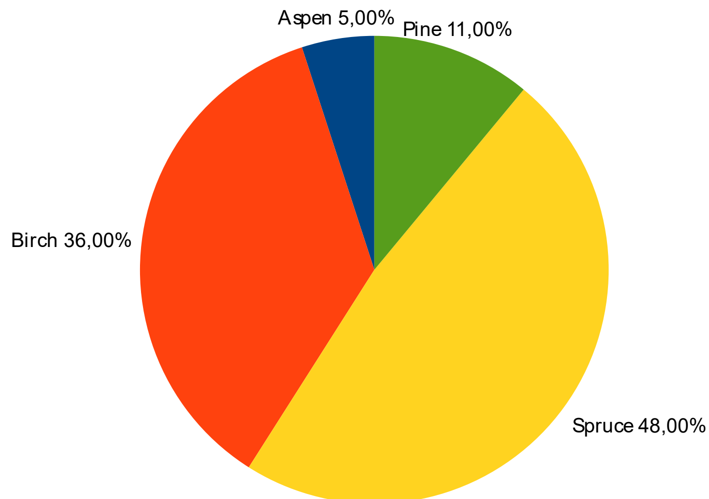

Figure 13: Dominant species in afforested lands

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.

Table 17: Summary of the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	ha	6 600
Total GHG reduction potential	tonnes CO_2eq.	3 935 472
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	48 666
	tonnes CO_2eq. $year^{-1}$ ha^{-1}	7.4

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

There are two measures under this activity – regeneration of forest stands after forest fires and other natural disasters, and maintenance and improvement of forest fire prevention system.

Regeneration of forest stands after natural disasters

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

According to the given assumptions, average additional increment of stem wood per rotation due to utilization of improved planting material in the forest regeneration 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 damaged by 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%

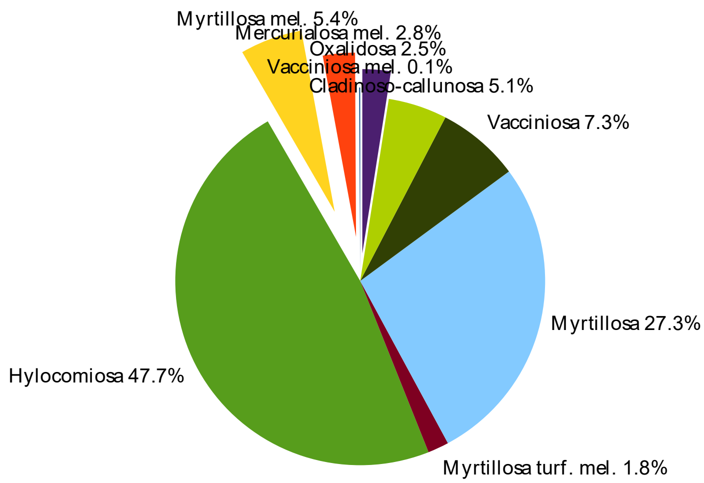

Figure 14: Distribution of the forest stand types in recent forest fire statistics

Summary of the impact of the measure is provided in Table 19. Duration of the impact of the activity is 100 years; however, most of the impact will be reached during the first 50 years.

Table 19: Summary of the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	kha	31
Total GHG reduction potential	tonnes CO_2eq.	1862524
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	18195
	tonnes CO_2eq. $year^{-1}$ 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 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 fire, hence the area of the forest fires is considerably smaller than it would be if the fire prevention system did not exist. Therefore, scenarios with and without fire prevention system are compared to evaluate climate change mitigation effect of this measure.

The measure decreases CO_2, CO, CH_4, N_2O and NO_x emissions. GHG emissions due to forest fires in Latvia are 133 tonnes CO_2eq. ha^{-1}. Total annual GHG emissions in forests due to forest fires in Latvia are very fluctuating; average annual GHG emissions since 1990 are 147 kilotons CO_2eq.

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

Table 20: Summary of impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area	kha	-
Total GHG reduction potential	tonnes CO_2eq.	-
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	-
	tonnes CO_2eq. $year^{-1}$ ha^{-1}	133.4

Improvement of ecological value and sustainability of forest ecosystems

The scope of the measure is to support pre-commercial thinning of young stands in private forests to ensure 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 thinning of young forest stands are proposed in the national legislation on forest management (Latvijas Republikas Saeima, 2000; Ministru Kabinets, 2012). 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 period according to Tier 1 approach. The long term impact is increase of growing rate (in average by 15 % annually, according to an expert judgement used in several growth models). Contribution to the dead wood stock is not evaluated yet due to lack of research data, therefore, only living biomass is considered in the impact assessment.

Emission 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. It is considered in the impact assessment, that the distribution of the dominant species (pine, spruce and birch)[6] in stands, where the measure will be implemented, is equal to distribution of these species in the previously thinned stands in private forests (Figure 15). The largest mitigation potential of the pre-commercial thinning can be observed in spruce stands.

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

6 No quantitative data are available for other species and they are not considered in calculation.

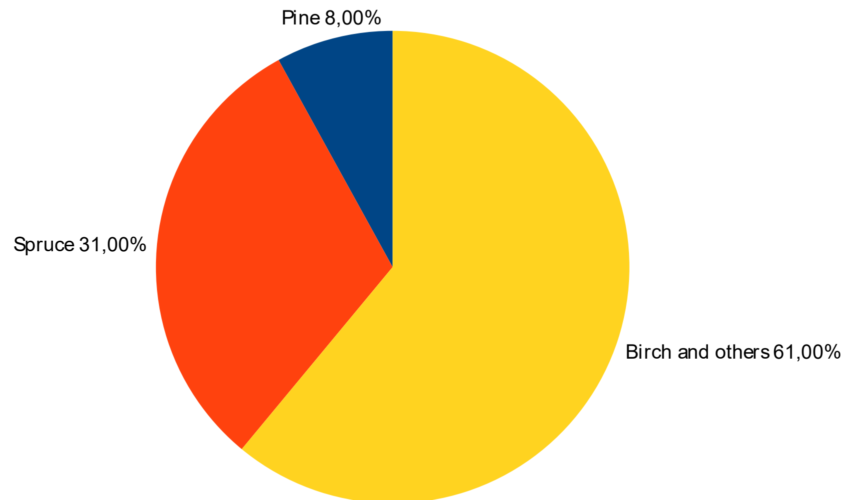

Figure 15: Dominant species in thinned lands in private forest

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.

Table 22: Summary of the impact of the measure

Parameter	Measurement unit	Value
Total potentially affected area according to projections of MoA	kha	15
Total GHG reduction potential	tonnes CO_2eq.	2196836
Average annual GHG reduction potential per area unit	tonnes CO_2eq. $year^{-1}$	28056
	tonnes CO_2eq. $year^{-1}$ ha^{-1}	1.9

New measures

There are no new measures introduced in LULUCF sector since the previous submission.

Identification of appropriate measures

Updated list of the measures is provided in Table 23. Not all of the measures will contribute to the GHG mitigation targets due to the fact that implementation rules differ from the initial assumptions or the measures are merged and their impact cannot be distinguished from other activities.

Table 23: Updated list of measures

Initially planned measures	Progress of implementation of measure	Quantitative estimation of measure
Development and adaptation of drainage systems in cropland	Measure is integrated in the complex measure "Investments in physical assets: Support for investments in infrastructure related to development, modernization or adaptation of agriculture and forestry - drainage systems" of RDP 2014-2020, support for measure is defined in the 30.09.2014 Regulation of the Cabinet of MinistersNo. 600.	Activity data of affected area are not available. Quantitative analysis on emission reduction is not made yet.
Support to introduction and promotion of integrated horticulture	Measure is integrated in a complex measure "Commitments of agri-environment and climate: Use of environmentally- friendly methods in horticulture [a better governance, reduction of use of mineral fertilizer and pesticide (including integrated production)]" of RDP 2014-2020, support for measure is defined in the 07.04.2015 Regulation of the Cabinet of Ministers No.171.	Quantitative analysis on emission reduction is not made yet.
Growing of legumes	Measure is integrated in the complex measure "Commitments of agri-environment and climate: Establishment of environmentally friendly land by cultivation of plants for nectar extraction" of RDP 2014-2020, support for measure is defined in the 07.04.2015 Regulation of the Cabinet of Ministers No.171.	Quantitative analysis on how measure is affecting GHG emissions reduction is not made yet.
Maintenance of biodiversity in grasslands	Measure is integrated in the complex measure "Commitments of agri-environment and climate: Maintenanceof biodiversity in grasslands"of RDP 2014-2020, support for measure is defined in the 07.04.2015 Regulation of the Cabinet of Ministers No.171.	Quantitative analysis on how measure is affecting GHG emissions reduction is not made yet.
Development and adaptation of drainage systems in forest land	Measure is integrated in the complex measure "Investments in physical assets: Support for investments in infrastructure related to development, modernization or adaptation of agriculture and forestry - drainage systems" of RDP 2014-2020, support for measure is defined in the 30.09.2014 Regulation of the Cabinet of Ministers No. 600.	Activity data of affected area are not available. Quantitative analysis on emission reduction is not made yet.
Afforestation and improvement of stand quality in naturally afforested areas	Measure "Investments in expanding of forest area and enhancing viability of forests: Support for afforestation and forest land establishment" is integrated in the RDP 2014-2020, support for measure is defined in the 04.08.2015Regulation of the Cabinet of Ministers No.455.	Quantitative analysis on emission reduction is not made yet.
Regeneration of forest stands after forest fires and other natural damages	Measure "Investments in expanding of forest area and enhancing viability of forests: Support for prevention and regeneration of forest stands after forest fires, natural damages and catastrophes" is integrated in the RDP 2014-2020, support for measure is defined in the 04.08.2015 Regulation of the Cabinet of Ministers No.455.	Quantitative analysis on emission reduction is not made yet.
Preventive measures of forest damages	Measure "Installation and improvement of forest fire, pest and diseases monitoring facilities and	Quantitative analysis on emission reduction is not made yet.

Initially planned measures	Progress of implementation of measure	Quantitative estimation of measure
	communication equipment" is integrated in the RDP 2014-2020, support for measure is defined in the 14.06.2016 Regulation of the Cabinet of MinistersNo.381.	
Improvement of ecological value and sustainability of forest ecosystems	Measure "Investments in expanding of forest area and enhancing viability of forests: Support for investments in improvement of ecological value and sustainability of forest ecosystems" is integrated in the RDP 2014-2020, support for measure is defined in the 04.08.2015 Regulation of the Cabinet of Ministers No.455.	Quantitative analysis on emission reduction is not made yet.

Existing and planned policies and their impacts

The progress on implementation of the climate change mitigation measures is summarized in Table 24. No quantitative estimates of the GHG mitigation effect are implemented due to the fact that the default accounting methods applied in the most of the measures requires longer period and can be calculated as periodic average.

There are several regulations implemented since previous submission for implementation of the measures listed in the Rural development plan 2014-2020, particularly:

- Regulations of Cabinet of Ministers No. 600 from 30.09.2014 on organization of assignment of support from European Union in open tender procedure for the measure “investments into material assets”;
- Regulations of Cabinet of Ministers No. 171 from 07.04.2015 on assignment, administration and supervising of the European Union support for improvement of environment, climate and rural landscape during the 2014-2020 planning period;
- Regulations of Cabinet of Ministers No. 455 from 04.08.2015 on assignment, administration and supervising of the European Union support for implementation of the “Investments into increase of the forest area and vitality of forests” measure;
- Regulations of Cabinet of Ministers No. 381 from 14.06.2016 on assignment, administration and supervising of the state and European Union support for implementation of the activity “Establishment and improvement of equipment and communication systems for monitoring of forest health, fires, pests and diseases” within the scope of sub-measure “Support for preventive forest measures and regeneration of forest in case of forest fires, natural disturbances and other extreme events” implemented under as a part of the measure “Investments in forest development and improvement of forest vitality”.

Table 24: Progress of the implementation of the RDP 2014-2020 climate change mitigation measures

Initially planned climate change mitigation measures	Initial prognosis of affected area	Name of the measure in the RDP 2014-2020	Activity code of the measure in the RDP 2014-2020	Identification code of the measure in the RDP 2014-2020	Reference of adopted legislation	Progress until 2016	Financial data, EUR		Level of implementation in 2016, %
							Planned total expenditure from the RDP 2014-2020	Implemented expenditures	
Development and adaptation of drainage systems in cropland	4.6 kha	Investments in physical assets: Support for investments in infrastructure related to development, modernization or adaptation of agriculture and forestry - drainage systems	M04	4.3.1	30.09.2014. Regulation of the Cabinet of Ministers No. 600	7.7	85 686 285	4 666 346	58%
Development and adaptation of drainage systems in forest land	12 kha					1.8			
Maintenance of biodiversity in grasslands	2 kha	Commitments of agri-environment and climate: Maintenance of biodiversity in grasslands	M10	10.1.1.	07.04.2015. Regulation of the Cabinet of Ministers No.171	1.3	31 302 670.00	2 134 411	65%
Support to introduction and promotion of integrated horticulture	0.5 kha	Commitments of agri-environment and climate: Use of environmentally - friendly methods in horticulture [a better governance, reduction of use of mineral fertilizer and pesticide (including integrated production)]	M10	10.1.2.	07.04.2015. Regulation of the Cabinet of Ministers No.171	349	7 114 360.00	862 934	70%
Growing of legumes	50 kha	Commitments of agri-environment and climate: Establishment of environmentally friendly land by cultivation of	M10	10.1.4.	07.04.2015. Regulation of the Cabinet of Ministers No.171	22.7	6 000 000	-	45%

Initially planned climate change mitigation measures	Initial prognosis of affected area	Name of the measure in the RDP 2014-2020	Activity code of the measure in the RDP 2014-2020	Identification code of the measure in the RDP 2014-2020	Reference of adopted legislation	Progress until 2016	Financial data, EUR		Level of implementation in 2016, %
							Planned total expenditure from the RDP 2014-2020	Implemented expenditures	
		plants for nectar extraction							
Afforestation and improvement of stand quality in naturally afforested areas	6.6kha	Investments in expanding of forest area and enhancing viability of forests: Support for afforestation and forest land establishment	M08	8.1.	04.08.2015. Regulation of the Cabinet of Ministers No.455	0.5	9 960 103	196 495	8%
Improvement of ecological value and sustainability of forest ecosystems	15 kha	Investments in expanding of forest area and enhancing viability of forests: Support for investments in improvement of ecological value and sustainability of forest ecosystems	M08	8.5.	04.08.2015. Regulation of the Cabinet of Ministers No.455	11.4	21 343 077	2 313 589	76%
Preventive measures of forest damages	-	Investments in expanding of forest area and enhancing viability of forests: Support for prevention and regeneration of forest stands after forest fires, natural damages and catastrophes, Installation and improvement of forest fire, pest and diseases monitoring facilities and communication equipment	M08	8.3./8.4.	14.06.2016. Regulation of the Cabinet of Ministers No.381	-	-	-	-
Regeneration of forest stands after forest fires and other	on demand	Investments in expanding of forest area and enhancing viability of	M08	8.3./8.4.	04.08.2015. Regulation of the Cabinet of	0.1	5 560 373	52 583	-

Initially planned climate change mitigation measures	**Initial prognosis of affected area**	**Name of the measure in the RDP 2014-2020**	**Activity code of the measure in the RDP 2014-2020**	**Identification code of the measure in the RDP 2014-2020**	**Reference of adopted legislation**	**Progress until 2016**	**Financial data, EUR**		**Level of implementation in 2016, %**
							Planned total expenditure from the RDP 2014-2020	**Implemented expenditures**	
natural damages		forests: Support for prevention and regeneration of forest stands after forest fires, natural damages and catastrophes			Ministers No.455				

The most successful measures up to now are "Improvement of ecological value and sustainability of forest ecosystems" and Maintenance of biodiversity in grasslands.

The climate change mitigation impact of the implemented activities is not estimated yet, because the most of the activities are in early implementation stages (approved, but not fully implemented). An estimate of potential impact of already implemented measures is shown in Figure 16. The estimate in Figure 16 considers that already implemented measure will continue for at least 20 years, respectively support for production of legumes or maintenance of biological diversity in grasslands in the specified areas will not be interrupted during this period.

If compared to the proposed climate change mitigation impact, currently implemented measures are equal to 52% of the total proposed impact of the measures in 2020 and 38% of the proposed impact of the measures in 2030.

The increase of carbon stock in mineral soil for the most of the measures is estimated using tier 1 methods of the IPCC 2006 guidelines. Tier 3 based methodology (Yasso model) will be implemented in further progress reports providing more detailed and accurate estimates of the climate change mitigation impact.

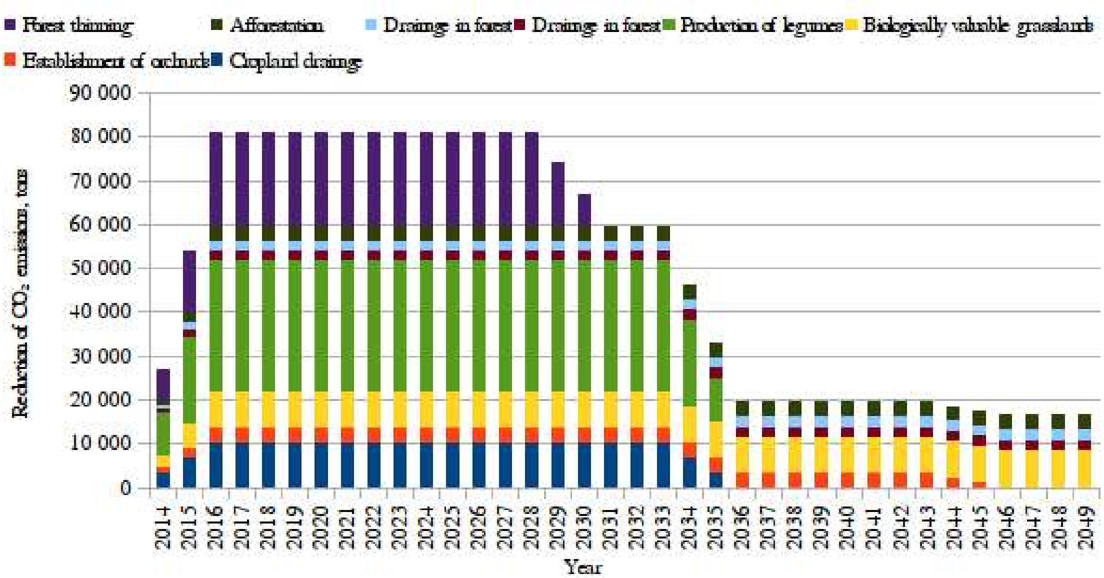

Figure 16: Potential impact of already implemented measures

Timetable for adoption and implementation of measures

Indicative timetable for the adoption and implementation of the measures is provided in Table 25. In Table 25 all mentioned measures are adopted in the legislation of the Republic of Latvia by legal acts – Regulations of the Cabinet of Ministers.

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

No.	Measure	Initially planned implementation of measure	Source	Legislation	Year of adoption of legislation
1.	Development and adaptation of drainage systems in cropland	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 600	2014

Progress report under LULUCF Decision 529/2013U Art 10

No.	Measure	Initially planned implementation of measure	Source	Legislation	Year of adoption of legislation
2.	Support to introduction and promotion of integrated horticulture	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No.171	2015
3.	Maintenance of biodiversity in grasslands	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 171	2015
4.	Growing of legumes	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 171	2015
5.	Development and adaptation of drainage systems in forest land	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 600	2014
6.	Afforestation and improvement of stand quality in naturally afforested areas	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 455	2015
7.	Improvement of ecological value and sustainability of forest ecosystems	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 455	2015
8.	Regeneration of forest stands after forest fires and other natural damages	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 455.	2015/2016
9.	Preventive measures of forest damages	Continuously in 2014-2020	Rural Development Programme 2014-2020	Regulation of the Cabinet of Ministers No. 381	2016

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