POLICY BRIEF

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GOVERNMENT'S ANALYSIS, ASSESSMENT AND RESEARCH ACTIVITIES

Perspectives into topical issues in society and ways to support political decision making

The role of the land-use sector in climate change mitigation

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Decreasing deforestation and increasing afforestation help Finland achieve climate commitments

In the new LULUCF accounts, the greenhouse gas emissions caused by deforestation and sinks created by afforestation are fully taken into account – contrary to forest sinks. The role of the land-use sector will therefore be emphasised in climate policy after 2020. Decreasing deforestation of peatlands will especially benefit the climate.

Deforestation can be decreased, among other things, by charging a fee for land-use change or tackling the reasons for deforestation. Agricultural land with low productivity and only minor importance for food production may qualify for afforestation. Afforestation potential can be estimated using the PeltoOptimi tool developed by Natural Resources Institute Finland (Luke).

Natural Resources Institute Finland undertook a project called "Potential of land-use measures in climate change mitigation (MISA)" as part of the Government's analysis, assessment and research activities. The project gathered new information on land-use change and analysed the reasons for them, collected information on effective practical measures the land-use sector can take to reduce the effects of climate change, and evaluated feasible policy instruments for the promotion of these measures. Information about climate benefits and disadvantages was produced to support land-use planning and policy. Furthermore, the long-term potential of the land-use sector to decrease greenhouse gas emissions was estimated and the need for the development of greenhouse gas inventories to consider practical measures for the land-use sector were discussed.

This publication is part of the implementation of the 2018 Government plan for analysis, assessment and research (www.tietokayttoon.fi/en).
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Measures for decreasing greenhouse gas emissions in the land-use sector

Deforestation means the conversion of land to non-forest use, e.g. agriculture, construction or peat production. The forest area is transformed to agricultural use if land required for agricultural production is not otherwise available. Deforestation can be prevented by setting a fee for land-use change. The need to convert forest areas to agricultural use can also be reduced by developing and applying manure management and new manure-processing solutions to minimise the environmental impacts of manure. Cooperation between farms can also be encouraged to utilise existing agricultural land primarily on mineral soils. Construction and peat production can also be regulated, for example through land-use planning.

Afforestation is typically implemented on abandoned agricultural land, grassland and peat production areas. Financial support can be used to promote afforestation. The introduction of financial support should, however, be closely linked to measures for reducing deforestation. Otherwise, it may promote afforestation in one area and unwanted deforestation in another.

Deforestation can be decreased and afforestation increased through various policy instruments

Other examples of feasible policy instruments for decreasing deforestation and increasing afforestation are compensation paid for carbon sequestration or transactions based on offers. Carbon emissions in one area can be compensated by promoting afforestation in another. Compensation for carbon sequestration paid to forest owners will prevent deforestation and promote afforestation. Through transactions based on land owners' offers, land owners may commit to the promotion of carbon sequestration in suitable land areas.

There are **other measures** for decreasing emissions or increasing carbon sequestration in the land-use sector, such as promoting plant cover on farmlands, controlling the water table or improving the soil structure and nutrient balance. Some measures of the current agri-environmental support scheme promote the reduction of greenhouse gas emissions. The largest emission reduction in relative terms can be achieved by increasing the proportion of grass cover and raising the groundwater level on cultivated peatlands.

Evaluation of the effects of land-use change

The climate benefits and disadvantages were estimated for the afforestation of agricultural land and grassland with deep and shallow peat layers, the clearing of forest for agriculture, and the transition from perennial to annual crops. The climate benefit was estimated using an emissions trading price level of €20/t CO_2 and assuming an annual interest rate of 3%.

The benefits of afforestation to the climate varied less and were lower than the disadvantages of deforestation (Table 1). For example, the climate benefit of afforesting a thin peat layer area with a perennial crop was assessed at €50/ha/year. For a thick peat layer with an annual crop it was €230/ha/year. The disadvantage of deforesting agricultural land with a thin peat layer was assessed at €210/ha/year and with a thick peat layer at €420/ha/year.

	Peat layer	Climate benefit Biomass eur/ha	Soil eur/ha	Total eur/ha	Total eur/ha/year
Cropland, annual crop → Forest land	thin	1,300	730	2,030	60
	thick	1,300	6,300	7,600	230
Cropland, perennial crop → Forest land	thin	1,300	410	1,710	50
	thick	1,300	4,140	5,440	160
Grassland → Forest land	thin	1,300	1,270	2,570	80
	thick	1,300	4,680	5,980	180
Cropland, annual crop → Perennial crop	thin	0	330	330	10
	thick	0	2,160	2,160	60
Forest land → Cropland	thin	-4,230	-2,690	-6,920	-210
	thick	-4,230	-9,900	-14,130	-420

Table 1: Estimates of climate benefits for some land-use changes on peatlands.

Due to the large share of forestry land (86%) of the total land area, afforestation potential is limited in Finland. The potential to decrease deforestation is also very low. In the last ten years, the annual area of forest converted to other land use has been ca. 0.1% of the total forest area, i.e. 19,000 ha. However, agricultural land on peatlands is unevenly distributed in Finland. This land may therefore be crucial for the continuation of agricultural production in some areas, while in other areas this land area may be allocated as set-aside land without affecting the quantity of agricultural production.

The long-term effects of land-use changes on greenhouse gases were evaluated using two scenarios.

In the **Baseline** scenario, land-use change was assumed to be similar to the average in 2005–2014 and to the linear projection estimated based on that period. Based on experts' opinions, restrictions were set for certain land-use categories. In addition, it was assumed that the area of agricultural land would not considerably increase or decrease.

For the **Forest+** scenario, the afforestation potential was estimated for different land-use categories. More specifically, the area of grassland afforestation was assumed to be nearly 140,000 ha in 2021. Furthermore, it was assumed that no peatland was cleared for peat production or agricultural use after 2020. After 2030, the production of peat for energy use was assumed to have ended, and the area of peatland for peat production for use in gardens, as litter and for pollution control was assumed to be 5,000 ha. The total area of peatland being replaced with afforestation in 2031 was assumed to be about 74,000 ha.

Figure 1 presents the annual development of afforestation and deforestation areas in alternative scenarios. In 2016 the net sink of the land-use sector was equivalent to 21.7 million tonnes CO_2 (Table 2). In the Baseline scenario, the sink increased to an equivalent of 49.6 million tonnes CO_2, and in the Forest+ scenario it increased to an equivalent of 52.8 million tonnes CO_2 by 2050.

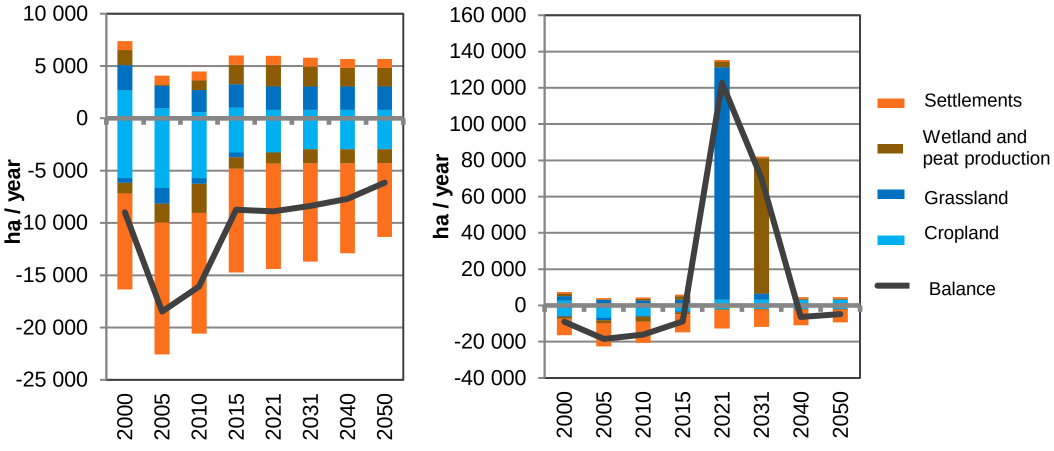


Figure 1: Annual areas of afforestation and deforestation in the Baseline scenario (on the left) and the Forest+ scenario (on the right).

million tonnes CO2 eq.	2016		2020		2030		2040		2050	
	Basel.	Forest+	Basel.	Forest+	Basel.	Forest+	Basel.	Forest+	Basel.	Forest+
Forest land	-29.43	-29.43	-38.45	-38.42	-38.24	-38.59	-48.08	-48.10	-59.03	-58.83
Cropland	6.93	6.93	6.70	6.70	7.54	6.89	7.67	6.59	7.84	6.35
Grassland	0.70	0.70	0.69	0.69	0.65	0.15	0.66	0.03	0.66	0.03
Wetland	2.26	2.26	2.22	2.22	2.10	1.81	2.03	0.70	2.01	0.73
Settlements	1.46	1.46	1.46	1.46	1.45	1.45	1.28	1.28	1.06	1.06
Wood products	-3.57	-3.57	-3.45	-3.45	-3.10	-3.10	-2.62	-2.62	-2.15	-2.15
TOTAL	-21.65	-21.65	-30.83	-30.79	-29.59	-31.39	-39.06	-42.13	-49.62	-52.80

Table 2: Estimates of the development of emissions and sinks in the Baseline (Basel.) and Forest+ scenarios, 2016–2050.

In the Baseline scenario, the sink created by afforestation remained close to the current level until 2050 (Table 3). In the Forest+ scenario, the effects of afforestation on the total balance were also minor.

In the Baseline scenario, the annual emissions caused by deforestation decreased from 3.4 million tonnes CO_2 to 2.4 million tonnes in 2050. The decrease was largest when the forest was cleared for agricultural use.

In the Forest+ scenario, the emissions caused by deforestation decreased to less than half the current level. In wetlands and grasslands, deforestation almost ceased and on agricultural land it was largely reduced.

million tonnes CO_2 eq.	2016		2020		2030		2040		2050	
	Basel.	Forest+	Basel.	Forest+	Basel.	Forest+	Basel.	Forest+	Basel.	Forest+
Afforestation										
Cropland	0.07	0.07	0.04	0.04	0.00	0.07	0.02	0.10	0.02	0.11
Grassland	-0.17	-0.17	-0.17	-0.17	-0.20	-0.71	-0.21	-0.60	-0.21	-0.23
Peat production	0.02	0.02	0.03	0.03	0.06	0.10	0.07	0.27	0.07	0.16
Other wetland	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Settlements	-0.08	-0.08	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07
Drainage CH_4, N_2O	0.03	0.03	0.02	0.02	0.02	0.07	0.03	0.11	0.03	0.06
TOTAL	-0.15	-0.15	-0.16	-0.16	-0.20	-0.55	-0.18	-0.21	-0.19	0.01
Deforestation										
Cropland	1.65	1.65	1.59	1.59	1.19	0.74	1.06	0.37	1.04	0.37
Grassland	0.12	0.12	0.12	0.12	0.10	0.01	0.10	0.00	0.10	0.00
Peat production	0.12	0.12	0.09	0.09	0.13	0.00	0.13	0.00	0.13	0.00
Other wetland	0.06	0.06	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.07
Settlements	1.44	1.44	1.44	1.44	1.43	1.43	1.26	1.26	1.04	1.04
TOTAL	3.39	3.39	3.31	3.31	2.92	2.25	2.64	1.70	2.39	1.48

Table 3: Estimates for the development of emissions and sinks produced by afforestation and deforestation in the Baseline (Basel.) and Forest+ scenarios, 2016–2050.

Based on the impact assessments, in the land-use sector, the effects of climate action are small compared with the total sink of forest land. The importance of reducing emissions through deforestation, afforestation and practical measures for agricultural land and grassland should not, however, be underestimated, because the changes in these emissions will be fully taken into account in the EU’s figures for greenhouse gases in the period 2021–2030. The benefits received from the sink of forest land are restricted in the accounts.

Needs for the development of the greenhouse gas inventory

In the greenhouse gas inventory, information is needed about the area of land-use change and emission factors or other methods for the evaluation of the magnitude of the effect. Under some land-use categories, more detailed classification is needed by area or emission factors. For example, the sink gained from afforestation can considerably vary in different sites. Therefore, refining this classification will produce more accurate estimates of the impacts.

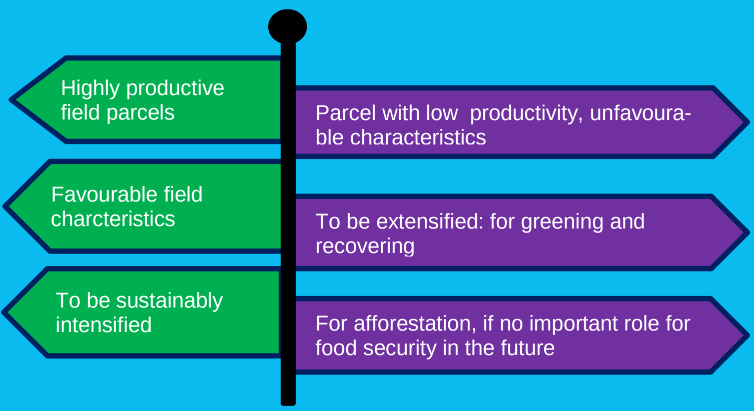
The development targets for the next few years are, for example, the reporting of methane emissions from open ditches on croplands and grasslands and the inclusion of different measures to raise the groundwater level. These measures include controlled drainage, paludiculture and restoration.

The refinement of estimates for organic matter input to soil concerning, for example, vegetation and organic amendments, would produce more accurate estimates for changes in soil carbon stocks.

New research is needed for many climate actions before estimates of their effects on emissions can be included in the report.

Using the PeltoOptimi tool for estimating afforestation potential

The PeltoOptimi tool developed in Natural Resources Institute Finland can be used for planning the climate-smart and productive use of agricultural land. The tool allocates field parcels, based on their productivity and other attributes, to different uses: sustainably intensified use; extensive farming; and afforestation. Farmers can use the tool for the pricing of land and for field parcel exchange and rearrangements.



Potential of land use measures in climate change mitigation (MISA) is part of the implementation of the 2018 Government plan for analysis, assessment and research.

Further information:

MISA project: research professor Tuula Packalen studies the consolidation of forestry and other types of land use.

Further information: https://www.luke.fi/en/personnel/tuula-packalen/

Policy instruments in agriculture: research professor Heikki Lehtonen studies the practical measures and policy instruments promoting the sustainability of agriculture.

Further information: https://www.luke.fi/en/personnel/heikki-lehtonen/

Policy instruments in forestry: research professor Jussi Uusivuori studies the effectiveness of financial instruments.

Further information: https://www.luke.fi/en/personnel/jussi-uusivuori/

Optimisation of agricultural land use: research professor Pirjo Peltonen-Sainio studies the sustainable rationalisation of plant production and the means to improve the resilience of agricultural systems.

Further information: https://www.luke.fi/en/personnel/pirjo-peltonen-sainio/

Effects of measures in the land-use sector on greenhouse gas emissions: research professor Kristiina Regina studies the mitigation of greenhouse gas emissions and soil carbon stocks in agriculture.

Further information: https://www.luke.fi/en/personnel/kristiina-regina/

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