Heikki Lehtonen, Sanna Saarnio, Jukka Rantala (MTK), Sari Luostarinen, Liisa Maanavilja, Jaakko Heikkinen, Katriina Soini, Jyrki Aakkula, Marja Jallinoja, Saija Rasi, Jyrki Niemi

Climate road map
Agriculture

MAATALOUDEN ILMASTOTIEKARTTA

Tiekartta kasvihuonekaasupäästöjen vähentämiseen Suomen maataloudessa

MTK

Luke
LUONNONVARAKESKUS

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SUMMARY IN ENGLISH

Finnish agriculture produced a total of about 16 Mt CO_2 eq. greenhouse gas emissions (GHG emissions) 2018. The road to a significant reduction in greenhouse gas emissions requires large-scale measures to reduce emissions from peatlands, increase carbon sequestration in mineral land, and changes in the use and production of energy in agriculture. These changes require new guidance and incentives for farmers, whose main task will continue to be to produce domestic food that meets consumer needs and preferences to about the same extent as in recent years. Efforts are being made to improve the sustainability of agricultural production in all respects, including profitability. The potential of agriculture to reduce greenhouse gas emissions varies widely. The implementation of significant reductions must therefore be carefully planned and implemented in different ways, so that all farmers can apply appropriate measures in cooperation with other farmers and operators.

According to producer organizations, domestic demand for food and agricultural products will not change significantly until 2035. Consumption of red meat, i.e. beef and pork, however, will decrease by about 20% and at the same time the domestic consumption of poultry meat will increase by 20%. Total demand for milk and various dairy products will decrease by about 10-15% by 2035. Domestic production will change at almost the same rate as these changes in demand, although favorable export trends may keep domestic consumption production at a higher level than domestic consumption. Demand for domestically produced legumes for feed and food is growing, as is demand for oats.

In the base scenario (WEM scenario; current policy instruments and trends in agriculture), greenhouse gas emissions will be reduced by only 5% by 2035 (6% by 2050). This means less than 1 Mt CO_2 eq. The base scenario assumes minor changes to the current situation in the agricultural markets and no changes in agricultural land use from 2018, or controls that affect it. Five percent reduction in emissions until 2035 is due to a slow reduction in the number of cattle, with agricultural production and land use largely unchanged.

The WAM scenarios (WAM1 and WAM2) are more ambitious and contain more measures to reduce GHG emissions than the baseline scenario. The WAM scenarios seek further reductions in greenhouse gas emissions from cultivated peatlands, increased carbon sequestration in mineral land and more biogas and solar energy in agriculture. These involve many measures in peatlands, such as less cultivation of annual plants, controlled underground drainage (higher water level than normal, e.g. 30 cm), restoration of peatlands with high water level (0-10 cm) and cultivation of wetlands. High water levels effectively reduce greenhouse gas emissions. In the WAM scenarios, the harvested crop yields will increase by 10% by 2035 and by more than 15% by 2050, especially through new plant varieties and their appropriate cultivation and precise use of production inputs. Higher yields can also be achieved by improving agricultural conditions through more diversified crop rotation and increased soil organic matter. The use of arable land will change significantly in a more diversified direction, as areas under cereals and the low-yielding part of forage grass production will decrease and free up arable land, especially for legumes and oilseeds, grasses used for biogas production, and green manure grasses. As a whole, carbon sequestration in mineral soils is clearly improved. Mineral land will change from the source of greenhouse gas emissions to their sinks in 2035. This will be improved by increasing the cultivation of collection plants and with multi-species grass in both fodder production and trees. Biogas and solar energy will be promoted through new controls and additional subsidies related to the utilization of the energy produced and improved the nutrient cycle in collaboration with various actors.

In the WAM1 scenario, greenhouse gas emissions will decrease by 29% from 2018 to 2035 and by 38% by 2050. This means about 6 Mt CO_2 eq. emission reductions in 2050. Of this approximately 1.9 Mt CO_2eq. is achieved through peatland measures and approximately 2.2 Mt CO_2 eq. is achieved through change in land use and targeted carbon sequestration of

mineral land. The change in energy use and production in agriculture also results in a small reduction in greenhouse gas emissions (0.2 Mt CO_2 eq.), As well as a reduction in the number of cattle, which is at the same level in the WAM scenarios as in the WEM scenario.

In the WAM2 scenario, greenhouse gas emissions from agriculture decrease by 42% by 2035 (77% by 2050) from 2018. This would mean approximately 12 Mt CO_2 eq. emission reductions in 2050 (6.8 Mt CO_2 eq. in 2035). Of this approximately 3.1 Mt CO_2 eq. would result from the application of various measures in larger scale on peatlands, in particular the restoration of peatlands, adjustable drainage and the afforestation of thin peatlands. In mineral soils, the target in this scenario is a large carbon sink up to 5 Mt CO_2 eq. year 2050 (2 Mt CO_2 eq. year 2035). This has been considered a highly targeted and ambitious scenario. At present, the high carbon sequestration target in the WAM2 scenario for mineral lands cannot be calculated using data and methods applied in the official greenhouse gas inventory, used by the Natural Resources Institute Finland (Luke). Assessing the achievement of the goal would require new materials and methods. The goal is challenging. It requires long-term work and improved and new solutions in carbon sequestration, where a special issue is not only to increase the carbon supply to soils, but also the duration of carbon in the soil, which entails great uncertainties, e.g. due to global warming. However, producer organizations have a strong will to achieve this goal.

Instead, the WAM1 scenario can already be considered achievable in terms of current knowledge, even realistic, if the challenges associated with incentives and control measures are addressed. In particular, this applies to the improved conditions for a farmer to be fully compensated for the loss of income as a result of the loss of agricultural subsidies on peatlands that have been restored, abandoned or afforested. In addition, peatlands need separate support and incentives to keep the water level high and to verify this. All this requires new resources of 300-500 million euros to be used in Finland for the period 2020-2050. In addition, resources are needed for technical development and application of methods such as precision cultivation, new, more productive and climate-resistant plant varieties, successful carbon sequestration and its verification on mineral soils, and successful restoration in peatlands. The use of these resources would be relatively low in the initial phase but would increase significantly by the 2030s, at the latest. This is because the development of new incentives, controls and their conditions, as well as technology and verification, take time. In addition, additional subsidies and marketing are needed to increase the production of bioenergy and nutrient recycling. A significant part of the additional resources should come from market-based activities. As a whole, agriculture in WAM1-scenario changes in a much more sustainable direction with several different sustainability indicators, so the use of public resources for change is also justified. The design of policy instruments over previous agricultural policy instruments is challenging and may require changes to certain conditions of existing instruments, such as special conditions of agricultural support, in order for the instruments to have the desired effect, for example to abandon low-yielding agriculture to achieve reductions in GHG emissions with low costs.

The above-mentioned reductions in greenhouse gas emissions can already be considered quite significant for the WAM1 scenario and already require extensive work at many levels to be achieved. Much also depends on whether progress is made with sustainable intensification in agriculture, which is behind both WAM scenarios. This means above all raising the crop yield levels and making a more accurate use of fertilizers and other inputs. This also means improving the growing condition of the fields, significantly diversifying the crop rotations and thereby improving the conditions for carbon sequestration in mineral land. All this is not easy but it is possible and already now it is the reality on many individual farms. There are many significant uncertainties and unresolved problems regarding both large-scale application of peatland measures, in particular rewetting peatlands (ie the raising of the water surface) and the effective carbon sequestration of minerals. Targeted solutions must be sought both at farm level and in research and development.

The measures leading to the development of emissions in the WAM scenarios require an environment in which the farmer benefits financially from the reduction of greenhouse gas emissions and related measures. If such an arrangement is not achieved, but the farmer has income losses, such as negative effects on agricultural production or losses of agricultural subsidies without corresponding benefits or compensation for losses, it will not be possible to achieve the greenhouse gas emission reductions presented in the WAM scenarios.

At the same time, effective and well-targeted policy instruments and controls enable the development of sustainable nutrient cycles and further reduced emissions. Biogas production creates solutions to the regional challenges of concentrated livestock production in the use of fertilizer nutrients and to improve the nutrient self-sufficiency in agriculture, i.e. replacement of mineral fertilizers. An integral part of the development to reduce greenhouse gas emissions is the promotion of agricultural energy production and the associated nutrient cycle (nitrogen, phosphorus, potassium). In the WAM1 scenario, biogas production and the associated nutrient cycle would be supported and promoted in many ways. Incentives would lead to a strong development of the market for both transport and industrial biogas and recycled fertilizer products, which would increase the diversion of agricultural materials to biogas production. In that case, more than a third of animal manure would be directed to biogas production. In 2050, the energy content of livestock manure -based biogas would increase to approximately 38% of the total energy potential of livestock manure as biogas. In addition, energy would be obtained in the WAM1 scenario from grasslands, especially in southern Finland with an area of 50,000 ha. A significant part of the animal manure would end up in large biogas plants, larger than farm size, which enables regional redistribution of nutrients.

In the WAM2 scenario, incentives and support measures for biogas production and nutrient cycles should be further improved. In that case, the production of biogas from agricultural biomass would increase further, especially the use of biogas in grasslands would clearly increase. The share of transport biogas and industrial biogas in the energy produced would increase significantly. The proportion of plants larger than the agricultural farm size of biogas plants would increase to increase the efficiency and control of transport's biogas production, especially in the direction of liquefied biogas for heavy transport.

The amount of energy produced from biogas in the WAM2 scenario would increase by 2050 to about 48% of the total energy potential for animal manure as biogas. In addition, energy would be obtained in the WAM2 scenario from 150,000 hectares of grassland, most of them in southern Finland. In this case, the proportion of grass for biogas would be higher than manure. By replacing fossil energy, emission reductions will be achieved on farms and in the surrounding areas, although the total impact on greenhouse gas emissions will remain relatively small, less than 0.5 Mt CO_2 eq. However, biogas energy produced from agricultural materials remains not only for agriculture, but cooperation between sectors in the production, processing and use of raw materials is essential. In the WAM1 scenario, it is estimated that at least 8 million kg of nitrogen fertilizer will be released from biogas plants to plant production farms. In the WAM2 scenario, it can be estimated that approximately 19 million kg of nitrogen fertilizer from biogas plants will be released to plant production farms. Approximately 150 million kg of inorganically industrially produced nitrogen fertilizer was spent in Finland in 2018. In addition, this figure could be 20% lower, 120 million kg in 2050 through sustainable intensification in the WAM scenarios. Biogas can therefore produce a significant part of the need for nitrogen fertilizer. In addition to climate change, biogas can contribute to other positive environmental consequences, such as air quality (less ammonia) and water status (less nutrient leaching). All this can be achieved through the sustainable utilization of digested residues from biogas plants in efficient nutrient cycles.

The large roof area of the agricultural production building and also the available land areas make the farms very suitable for the construction of solar power plants. Production growth is particularly limited by the fact that 90% of production is generated in March-September and that only solar energy produced for own use is eligible for investment support. Extending investment support to power plants and batteries planned for sale, temporary compensation of sales, facilitating the formation of energy communities, realization of virtual batteries and incentive tax treatment of outgoing electricity would accelerate the realization of solar power investments on farms. It would be possible to cover about 8% of the electricity consumption for farms with solar cell oil by 2035 and about 14% by 2050. During the summer months, solar energy in combination with a battery can make individual farms completely self-sufficient.

The climate measures and policy instruments to promote them on a large scale also have significant social and cultural consequences. Changes in the operating environment and society's expectations affect both the competence requirements and the farmers' professional image, especially in the WAM1 and WAM2 scenarios. In the WAM1 and WAM2 scenarios, food production is increasingly integrated into climate measures. Large farms in grain and animal husbandry have better economic opportunities for the introduction of new technology and production methods required by climate measures.

The network-based strategy takes over the sector, which in the WAM2 scenario enables large-scale biogas production that successfully combines decentralized and centralized solutions. Involving small and remote farms in this development based on efficient division of labor and cooperation, as well as technical change, is challenging, but can be solved through networks. If farmers do not know the changing goals or culture of agriculture and consider them as their own, it can lead to ambiguities or conflicts about their own professional image. In the scenarios, measures and development costs are not targeted at all farmers in the same way. Individual farmers are in a different position depending on the characteristics of the farm and the climate measures that have already been taken before. Therefore, when planning climate action, the encounter with different social and cultural effects must also be determined in advance. The development described in the WAM2 scenario can only work if policy guidelines for climate action are implemented in such a way that all farmers consider that they have common goals.

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The measures to reduce greenhouse gas emissions were considered both to reduce and increase water pollution and biodiversity in the field. The reduction of active agricultural activity and the replacement of traditional field use with new agricultural methods and partly also with land use changes will create more different field environments and provide more space for wild species. The same changes will also reduce nutrient effluent to watercourses in the long term. On the other hand, changing land use may put a significant strain on local waterways in the short term. In addition, the rural landscape will change and the area suitable for fields will decrease. It is not self-evident that society largely understands and appreciates the change in the agricultural landscape and field use that would result from a sharp reduction in greenhouse gas emissions.