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Sustainable Cultivated Landscapes in Germany: Goals and Requirements from an Ecological, Economic and Legal Perspective

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Abstract

The global increase in greenhouse gases is also changing the climate conditions more severely in Germany. This particularly affects local cultivated landscapes, which cover large parts of Germany and are already experiencing a wide range of ecological problems. Although agricultural land use characterises cultivated landscapes, their sustainability does not only depend on a change in farming methods. The creation of sustainable cultivated landscapes requires an approach that goes beyond individual actions, which is rather a task for society as a whole that extends well beyond the responsibility and possibilities of individual landowners and managers. Based on the common ecological problems and the specific challenges of climate change described in more detail in the article, we therefore analyse what sustainability means and which social goals and requirements can be identified for cultivated landscapes. The article aims to create a basis for developing practical concepts for measures, government regulations and state subsidies.

Keywords: climate change, cultivated landscape, agriculture, forestry, sustainability, international law, European law, constitutional law, nature conservation, ecosystems, biodiversity

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1 Introduction

Germany is predominantly made up of landscapes where the proportion of land used for agriculture (arable land, grassland and speciality crops) is more than 50 per cent. These landscapes, referred to in the following as cultivated landscapes, also include settlements, transport infrastructure and smaller areas of forest and water. Due to the heterogeneous geological, topographical and climate conditions, there are numerous types of cultivated landscapes in Germany.[1] At the same time, they have been subjected to anthropogenic changes to a greater or lesser extent over the course of a long history of settlement.[2] They range from cleared and almost completely arable landscapes to topographically small-scale landscapes with high proportions of meadows, forests or speciality crops such as grapes.[3]

For a long time, natural site conditions determined the type of agriculture. Extensive mechanisation and the availability of inexpensive commercial fertilisers made it possible to overcome many disadvantageous natural site conditions using fossil fuels. Within so-called large-scale soil landscapes[4] , the types of cultivation characterised by short crop rotations and increasing field sizes have become very similar, while at the same time agricultural- and wildlife-biodiversity have declined.[5]

However, cultivated landscapes are not only the areas where agricultural goods are produced, but also a habitat for more than half of the population living outside of large cities.[6] This proportion of the population is directly affected by any changes in these cultivated landscapes and is exposed to agricultural emissions such as ammonia, particulate matter and pesticides. At the same time, cultivated landscapes harbour diverse local ecosystems and habitats and are themselves integrated into supra-regional ecosystems and natural material flows. The design of cultivated landscapes and their management (especially in agriculture, forestry and the water balance) therefore greatly influences their quality as habitats and the functionality and performance of local and regional ecosystems.[7]

This also applies to their resilience and vulnerability to the effects of global warming, which is increasingly changing the climate site conditions in Germany.[8] In particular, the quantitative and (seasonal) temporal changes in precipitation conditions and water availability are having a more frequent impact on local cultivated landscapes.[9] Moreover, repetitive loops in the northern jet stream have repeatedly led to extreme droughts or precipitation in Germany in recent years.[10] The vulnerability of cultivated landscapes to climate change and extreme weather events is all the more apparent, the more disturbed, overused or impoverished the soils, water bodies and habitats are.[11]

Climate change therefore increases the urgency to address existing environmental impacts in cultivated landscapes, while improving the condition of ecosystems and increasing biodiversity.[12] At the same time, cultivated landscapes are also called upon to become climate-neutral and, in the long term, to act as CO_2 sinks to offset unavoidable residual emissions from other sectors,[13] in order to keep global warming well below 2° C and, if possible, no more than 1.5° C compared to pre-industrial times, in line with the Paris Agreement.[14] This requires both a far-reaching move away from fossil fuels in the entire agricultural sector (including the industrial production of fertilisers and pesticides) and the greatest possible minimisation of agricultural greenhouse gas emissions, which particularly

arise from the agricultural use of peatlands and the conversion of natural grasslands, the use of pesticides and the keeping of livestock.[15]

Overall, cultivated landscapes face the following key challenges:

- to adapt cultivated landscapes to the already noticeable impacts of climate change;
- to reduce the negative impacts of agricultural use on people and the environment;
- to decarbonise agricultural production and increase the sink capacity of soils and forests, and
- to stop the outflow of people.

A need for change especially in agricultural management has become generally recognised, partly due to its immense environmental impact,[16] as the Commission on the Future of Agriculture convened by the German government in 2020 also states in its unanimously adopted final report:

> "Various factors, not least political ones, have led to economic practices that are neither ecologically nor economically and socially sustainable (...). Agriculture (is) less and less able (...) to operate in sustainable material cycles within the limits of natural resources. In view of the external costs that the prevailing forms of production entail, an unchanged continuation of the current agricultural and food system is not an option on the grounds of ecological, and ethical animal husbandry as well as economic reasons."[17]

However, due to the massive forest dieback in monocultures in Germany since the drought years 2018 to 2020 and the subsequent explosion in bark beetle populations, there is also an urgent need for action in forestry to restructure forests and restore their resilience through greater diversity and more climate-adapted tree species.

Section 2 of the following article analyses the potential impacts of climate change on cultivated landscapes in more detail. However, the various environmental impacts of agricultural production on biodiversity, soils, water bodies and air due to land conversion and cultivation as well as different material inputs and emissions are not presented, as in-depth analyses are available.[18] Based on the problems outlined above, Section 3 develops an understanding of sustainable cultivated landscapes in order to identify the relevant ecological and social requirements and objectives. By objectives, we mean societal intentions that can be regarded as a societal consensus, whereas more specific requirements are derived from the requirements of relevant natural, economic or social processes, whereby the transition between the two categories is fluid.

This article is part of a larger research project and marks the beginning of a series of articles. It forms the basis for the following studies on practical measures for establishing sustainable cultivated landscapes in Germany as well as potential paths for governance and instruments for achieving the identified goals and requirements and for implementing the identified measures.

2 The impacts of climate change in Germany

According to the current state of research, the global rise in average temperatures will affect local cultivated landscapes in numerous ways (see Table 1), whereby the projected impacts in so-called hotspot regions may be significantly higher than the national average.[19] The most important impacts of climate change for Germany are an increase in the number of hot days and dry periods, an increase in the frequency of strong winds and heavy precipitation and, for some regions of Germany, a decrease in (seasonal) precipitation.[20]

The future probabilities and intensities of climatic change in Germany depend on further increases in greenhouse gas concentrations. Based on the IPCC Assessment Reports, a distinction can be made between so-called 'Representative Concentration Pathways' (RCP). In the "Climate Impact and Risk Analysis 2021 for Germany" commissioned by the German government[21] , the "continue-as-before" scenario RCP8.5 was used as a guideline, as it is currently considered to have a non-negligible probability of occurrence,[22] even if current climate protection announcements raise hope for a more climate-friendly scenario.[23] At present, however, CO_2 concentrations in the atmosphere are continuing to rise sharply and despite all international agreements and pledges, there is still no sign of a trend reversal.[24] The atmospheric levels of methane (CH_4) and nitrous oxide (N_2 O),[25] are also rising sharply which are 28 times and 265 times more harmful to the climate than CO_2 respectively.[26] Even taking into account the climate protection measures announced by the international community, the Paris Agreement target of maximum global warming of well below 2 °C and preferably only 1.5 °C is becoming increasingly more distant. [27]

One of the main sources of global nitrous oxide and methane emissions is agriculture.[28] In Germany, agriculture accounts for 63% of total methane emissions and 81% of nitrous oxide emissions.[29] While methane emissions from livestock and agriculture are produced during the treatment of farm manure and as a result of fermentation processes from renewable raw materials, nitrous oxide escapes from agricultural soils as a result of mineral and organic nitrogen fertilisation.[30] According to the Federal Environment Agency, agriculture was responsible for around 9 % of German greenhouse gas emissions in 2020,[31] even though emissions from drained peat soils and from the production of industrial fertilisers and pesticides were not attributed to agriculture.

The uncertainties surrounding the future development of global greenhouse gas emissions grow with various feedback processes, dynamics and tipping points. Regional statements in particular are still rough trends, even if mathematical models appear to generate concrete figures[32] with exact future developments remaining uncertain. This particularly applies to the extent and location of extreme events and to their impacts on complex ecosystems and ecosystem services,[33] In spite of a certain CO_2 fertilisation effect, current global studies[34] assume a deterioration in cultivation conditions and yields for many agricultural crops in many regions of the world in the medium to long term.[35]

This means that the resilience of natural and anthropogenic systems to deviations from the long-term average is all the more important. As most of the relevant sensitivity factors in this respect relate to the use of natural resources (especially water and land), "increased protection of natural resources from anthropogenic overuse / overexploitation is key" when adapting to climate change.[36] Currently, vulnerability to climate-related changes is high and

resilience is greatly reduced because of low agricultural diversity, large-scale agriculture and the clearing of agricultural landscapes. [37]

Table 1: Projected changes to the climate in Germany and expected impacts on cultivated landscapes[38]

Projected changes to the climate for Germany	**Impacts on cultivated landscapes**
Increase in the average temperature **Uncertainty**: • low to medium depending on IPCC scenario and observation period[39] **particular uncertainty factor**: • Weakening of the Gulf Stream [40] **Current status**: • annual average +1.5 °C since 1881[41]	• Longer vegetation periods and phenological changes (e.g. flowering times) • Increase in northward migrating invasive species, pathogens and beneficial organisms • Shift in climate zones and thus the suitability of crops • Increased evaporation rates for soils and plants • Increasing microbiological activity in the soil with, among other things, increased metabolic decomposition of humus and the organic carbon it contains, releasing nutrients and greenhouse gases (especially CO2) • Deterioration of the ecological status of water bodies
Change in precipitation **Uncertainty:** • average with regard to general trends depending on the IPCC scenario • high in terms of exact scope[42] **particular uncertainty factor**: • Weakening of the warming Gulf Stream [43] **Current status:** • annual average increases of around 9 % since 1881 with the highest increase of 25 % in the winter months [44] • Significant decrease in summer precipitation and water availability since 2013[45] • in comparison of the periods 1961-1990 and 1989-2018 Increase of 4% in autumn and winter and decrease of 8% in spring[46]	• Seasonal shifts (with more precipitation in winter, less in summer) • Regional changes with a) landscapes that are becoming drier (e.g. Saxony): o Less groundwater recharge and water runoff in watercourses as well as an increase in the concentration of nutrients and other pollutants (e.g. pesticides and antibiotic residues) in water bodies o Less water extraction potential in summer o Less fungal diseases in plants, provided there is no drought stress o Changes in cultivation conditions, ecosystems and habitat characteristics b) increasingly humid landscapes (e.g. Schleswig-Holstein): o More groundwater recharge and water runoff and a reduced concentration of pollutants in water bodies o More fungal diseases in plants o Changes in cultivation conditions, ecosystems and habitat characteristics
Increase in the frequency, impact and duration of more extreme weather events **Uncertainty:** • means of increasing the probability of occurrence[47] • High to absolute uncertainty regarding when, where, how often and how intense **particular uncertainty factor:** • Northern jet stream[48]	• General increase in the risk to and impact on existing vulnerabilities of animals, plants, ecosystems, water bodies and soils • pronounced regional drought, heat, cold or precipitation events possible if the northern jet stream expands or collapses ("Omega pattern")[50]

Current status: • Increase in the frequency of hot days and the intensity of heat waves; decrease in icy days[49]	
➢ **Droughts & hot spells**	• Water scarcity in soils inhibits plant growth and can lead to the death of crops in the long term • Competition for available water between catch crops and main crops • Premature, insufficient ripening of crops • Drought and heat stress for wild animals and farm animals and plants (including growth disturbance, death, increased susceptibility to diseases and pests) • Changes to ecosystems with loss of habitat characteristics (e.g. drying out of water bodies, wetlands, bogs) • Reduction in groundwater recharge and water runoff in watercourses as well as an increase in the concentration of nutrients and other pollutants (e.g. pesticides and antibiotic residues) in water bodies • Reduction in water extraction potential the longer the drought lasts • Increasing microbiological activity in hydromorphic soils and peat soils with, among other things, increased metabolic decomposition of humus and the organic carbon it contains, releasing nutrients and greenhouse gases (especially CO_2) • Declining microbiological activity and biodiversity in drying soils • Increased risk of fire and wind erosion
➢ **Ice periods**	• Frost damage to crops at unfavourable times (especially at the time of flowering and emergence in the spring) • Reduction of groundwater recharge and water runoff in watercourses • Sharp decline in microbiological activity in soils • Loosening of soils from frost with, among other things, an increase in water absorption capacity but also the risk of erosion
➢ **Storms**	• Soil erosion due to wind erosion • Drying out of soils during storms without rain • Damage to crops and trees • Intensification of fires during storms with low rainfall
➢ **Floods & heavy rainfall**	• Removal of soil due to water erosion • Siltation due to deposited sediments • Input of pollutants (e.g. heavy metals, chemicals) • Damage to crops and trees in the event of flash floods, hail or prolonged flooding • Restrictions regarding field cultivation

3 Goals and requirements for sustainable cultivated landscapes

The sustainability of a landscape means that its respective features and specific functionalities are also guaranteed over longer periods of time. In line with the definition of sustainable development in the Brundtland Report[51], a sustainable landscape should be able to satisfy not only the needs of the present but also those of future generations and continue to provide as many options for use as possible in the future. In this context, basic needs (especially food security) are of particular relevance and cannot be substituted.

In 1994, the German Advisory Council on the Environment described the term "sustainable development" as "development that is sustainable and environmentally sound" in order to emphasise that, in addition to the temporal dimension, sustainable (positive) development must be geared towards the carrying capacity of ecosystems and must not jeopardise them.[52] As with the later concept of planetary boundaries[53], this includes recognising natural limits to the use of ecosystems and natural resources.

From this, proponents of the so-called strong sustainability concept derive a prioritisation of ecological requirements over economic and social concerns.[54] One of the reasons for this prioritisation is that humans, as biological beings, are essentially dependent on certain ecosystem services (including oxygen, water, food, regulation, decomposition of residual and harmful substances such as CO_2) and stable climate conditions[55] and that both human societies and their economies can only prosper in the long term within these ecological boundaries. The vast majority of ecosystems and natural resources cannot be substituted and economic or social benefits rarely compensate for an excessive degradation of natural capital, as the long-term social and economic impacts and the costs of ecological degradation usually outweigh any previous benefits.[56]

The following analysis is also based on this understanding of sustainability. Sustainable cultivated landscapes are landscapes where, on the one hand, agricultural, forestry and other land uses can be carried out in the long term and, on the other hand, the performance of the ecosystems and the quality of the habitat are maintained or, if degraded, restored. Both are only possible by adapting to climate change. By safeguarding ecosystem services and biodiversity, it is possible to ensure positive long-term effects on the yield and adaptation potential of agricultural and forestry land use.[57]

On the other hand, we do not consider an economically and socially motivated maximisation of agricultural production with extensive degradation of ecosystem functions and an extensive displacement of wild plants and animals to be sustainable, as this would mean that the necessary, non-technically substitutable services of nature must be provided by other landscapes and thus the intensively used agricultural landscape only exists in the long term due to and at the expense of other landscapes. However, an extensification of domestic agricultural production should not lead to a further reduction in the degree of self-sufficiency and to increasingly more agricultural products being imported from other countries, thereby increasing the pressure to convert natural and forested areas into agricultural land in exporting countries. Furthermore, the country´s high dependency on imports (in particular for fruit and vegetables, oilseeds and animal feed) jeopardise local security of supply in the event of global crop failures or the collapse of supply chains (e.g. resulting from the pandemics, wars, export restrictions)[58] – even if the integration into global markets can help

to cushion local and regional crises.[59] The problem of shifting environmental demands applies to both the entire German and European agricultural and food systems, as Europe as a whole imports significantly larger quantities of agricultural goods than it exports,[60] while at the same time releasing its greenhouse gases and nutrient surpluses into the atmosphere and oceans.

Sustainable cultivated landscapes that have adapted to climate change therefore require ecological intensification, whereby the environmental impact is reduced but yields are maintained at the highest possible level.[61] The greening of agricultural production should also go hand in hand with a significant increase in the proportion of plant-based food in the domestic diet, as around two thirds of agricultural land in Germany and for imported animal feed even larger areas in other countries are currently used for the production of animal-based foodstuffs.[62] According to the Commission on the Future of Agriculture, avoiding negative externalities without shifting production is an important condition for transforming the food and agricultural system, taking planetary boundaries into account, in such a way that the ecological compatibility and resilience of agricultural production - particularly with regard to the impacts of climate change - are improved in line with ecological requirements and challenges.[63]

In Table 2, we have worked out the ecological and social requirements and objectives for sustainable and environmentally sound cultivated landscapes in Germany, picking out the most indispensable and important requirements and objectives. This includes aspects that are oriented towards the basic social requirement of "preserving the natural foundations of life and favourable environmental conditions that we rely on as human beings"[64]. With regard to cultivated landscapes in particular, a large number of social needs and objectives underpin or supplement this fundamental social requirement. They range from the security of food and raw materials to the generation of ecosystem services and the use of land for settlement, transport and recreation. Individual goals and requirements sometimes compete with one another, as the UN's Sustainable Development Goals (SDGs) point out.[65]

Many social objectives have already been legally defined or agreed upon at the international, European, national and regional level through political decisions. This applies to ecological as well as economic and social objectives. Due to the legal form and the necessary legislative procedures, these objectives are not only more stable than pure political declarations of intent or administrative strategies, but are also legitimised by humanity or the respective societies as a whole - albeit in different ways and usually by majority decisions rather than consensus. In the social analysis, we therefore limited ourselves to legally standardised objectives and supplemented these with basic requirements from a social and economic perspective, even if the various political strategies, such as the strategies on agriculture, biodiversity and soils of the European Commission as part of the European Green Deal[66] or the national strategies on agricultural farming, peatlands, biodiversity or the bioeconomy[67] contain more specific objectives. When it comes to legally defined objectives, we prioritise the objectives laid down in international, European and constitutional laws, as these higher-ranking laws require compliance and implementation by national legislators at the federal, state and local levels. The simple legal acts and the objectives often formulated therein (e.g. in Section 1 of the Federal Nature Conservation Act, Section 1 of the Federal Soil Protection Act, Section 1 of the Federal Water Act, Section 1 of the Fertiliser Act) serve to implement these higher-ranking objectives and are therefore not listed in Table 2.

With regard to sustainable, environmentally friendly and climate-adapted cultivated landscapes, four fundamental objectives stand out, some of which overlap and are mutually dependent:

- the preservation or restoration as an environmentally and socially sustainable habitat for humans and wild species;
- the conservation or restoration of ecosystems within cultivated landscapes with their diverse functions and services;[68]
- to maintain suitability for the production of agricultural products (food, animal feed and biogenic or energy raw materials) and
- Climate neutrality and, if possible, to function as a greenhouse gas sink.

Table 2: Objectives and requirements for sustainable cultivated landscapes in Germany from an ecological, legal and economic perspective (random numbering without prioritisation)

	Goals & requirements	**Scientific justification and legal basis**
	General goals	
1	Preservation of natural resources and favourable environmental conditions necessary for human life	· Prerequisite for the life, health, dignity and freedom of people and for the existence of a free and democratic constitutional state · Art. 1, 2, 20 and 20a GG[69] · Art. 2, 3 and 6 TEU[70] · Regulation 2024/1991 on nature restoration · Framework Convention on Climate Change (UNFCCC)[71] · Convention on Biodiversity (CBD)[72]
2	Preservation or restoration of cultivated landscapes as a sustainable, environmentally and socially just habitat for people	· Prerequisite for the conservation of natural resources and favourable environmental conditions necessary for human life · A prerequisite for life, health, dignity and the exercise of freedom in cultivated landscapes · Art. 1, 20a GG · Regulation 2024/1991 on nature restoration · Art. 5 Regulation 2021/2115/EU[73] · Art. 5 European Landscape Convention[74] · Agenda 21 and Agenda 2030[75]
	Ecological goals	
3a	Conservation or restoration of ecosystems, their functions and services in cultivated landscapes	· A prerequisite for the long-term conservation of natural resources and favourable environmental conditions · Art. 20a GG · Art. 11, 191 TFEU[76] · Art. 10-12 Regulation 2024/1991 on nature restoration · Art. 6 para. 1 lit. f) Regulation 2021/2115/EU · CBD · Agenda 21 and Agenda 2030

3b	Conservation of biodiversity	· A prerequisite for the long-term preservation of ecosystems, their functions and services and thus for the preservation of the natural resources on which life depends · Art. 20a GG · Art. 6 para. 1 lit. f) Regulation 2021/2115/EU · CBD · Agenda 21 and Agenda 2030
3c	Maintain or restore favourable conservation statuses for protected and particularly endangered species and habitats, including the green connectivity structures required for genetic exchange	· A prerequisite for the long-term conservation of ecosystems, their functions and services and thus for the preservation of the natural resources on which life depends · Art. 20a GG · Art. 11, 191 TFEU · EU Habitats Directive 92/43/EEC · EU Birds Directive 2009/147/EC · Art. 4, 10-12 Regulation 2024/1991 on nature restoration · Art. 6 para. 1 lit. f) Regulation 2021/2115/EU · Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979 (CMS)[77] · Bern Convention on the Conservation of European Wildlife and Natural Habitats 1979[78] · Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat 1971[79]
3d	Maintain or restore good ecological and chemical conditions in non-artificial surface waters and the seas (in Germany the North Sea, Baltic Sea and Black Sea)	· A prerequisite for the long-term preservation of aquatic ecosystems, their functions and services · A prerequisite for the conservation or restoration of biodiversity and favourable conservation statuses for protected and particularly endangered species and habitats · Art. 20a GG · Art. 11, 191 TFEU · EU Water Framework Directive 2000/60/EC · EU Marine Strategy Framework Directive 2008/56/EC · Art. 4, 5 Regulation 2024/1991 on nature restoration · OSPAR and HELCOM
3e	Maintain or restore good quantitative and chemical conditions in groundwater bodies	· A prerequisite for good surface water conditions · An important condition for climate protection (preservation of carbon-rich peatland and floodplain soils) and for the adaptation to climate change · Art. 20a GG · EU Water Framework Directive 2000/60/EC · EU Groundwater Directive 2006/118/EC · Art. 4 and 11 Regulation 2024/1991 on nature restoration
3f	Maintain or restore good ecological and chemical conditions in soils	· A prerequisite for the long-term conservation of ecosystems, their functions and services and thus for the preservation of the natural resources on which life depends · A prerequisite for the long-term conservation of agricultural and forestry production and security of supply for food, water and biomass · Increase of humus content is an important climate protection measure · Art. 20a GG · Art. 11, 191 TFEU · Art. 4, 11 and 12 Regulation 2024/1991 on nature restoration · Agenda 21 and Agenda 2030

3g	Maintain or restore the ability of soils to absorb and store water and create retention areas	· A prerequisite for effective and efficient flood protection · A prerequisite for climate adaptation in agriculture and forestry · Art. 2, 14, 20a GG · EU Water Framework Directive 2000/60/EC · EU Flood Management Directive 2007/60/EC
3h	Climate neutrality and, if possible, to function as a greenhouse gas sink	· A prerequisite for achieving climate neutrality in Germany by 2045 and maintaining favourable environmental conditions with less than 2° C global warming · Art. 2, 14, 20a GG[80] · Art. 11, 191 TFEU · European Climate Law Regulation (EU) 2021/1119 · EU GHG target regulation 2018/842/EU · EU LULUCF Regulation 2018/841/EU · EU Energy Union Governance Regulation 2018/1999/EU · Paris Agreement 2015[81] · UNFCCC · Agenda 21 and Agenda 2030
	Economic goals	
4a	Internalisation of external effects	· A prerequisite for the fair distribution of responsibility for ecological or social consequences of one's own actions · A prerequisite for ecologically and socially fair prices, balance sheets and decisions at the macroeconomic, company and private level · A prerequisite for the implementation of the polluter pays principle and the principles of precaution and combating environmental damage primarily at its source · A prerequisite for an economic optimum use of scarce resources (money, personnel, time, natural resources such as land, energy, water) including scarce financial and personnel resources of the state · Art. 3, 20a GG · Art. 191 (2) TFEU · Art. 9 EU Water Framework Directive 2000/60/EC
4b	Effectiveness and efficiency of government funds and measures	· A prerequisite for good public financial management of scarce financial and human resources · A prerequisite for economic optimum use of scarce resources (money, personnel, time, natural resources such as land, energy, water) · A prerequisite for the acceptance and achievement of sustainable, environmentally friendly (agricultural) land use in agricultural landscapes · Art. 33 EU Budget Regulation 2018/1046 regarding measures by European institutions
	Social goals	
5a	Equality in living conditions throughout Germany and the EU	· A prerequisite for the preservation of cultivated landscapes as a socially just habitat for people · Art. 3, 72 para. 2 GG · Art. 8 TFEU

5b	Maintain or restore social infrastructures, especially for day-to-day care and medical care, education, mobility and communication	· A prerequisite for equal living conditions and preservation as a socially just living space for people · Art. 3, 72 para. 2, 87 para. 1, 87e, 106a GG
	Specific objectives in the area of agriculture and food	
6a	Sustainable and environmentally sound management and utilisation of cultivated landscapes	· A prerequisite for the long-term conservation or restoration of natural resources and favourable environmental conditions, ecosystems, wild species, water bodies and soils · Art. 14 para. 2, 20a GG · Art. 11, 191 TFEU · Regulation 2024/1991 on nature restoration · Art. 5 and 6 para. 1 lit. d-f) Regulation 2021/2115/EU · Agenda 21 and Agenda 2030
6b	Significant reduction in nutrient and pollutant loads to protect ecosystems	· A prerequisite for human life and health · A prerequisite for the conservation and restoration of ecosystems, favourable conservation status of protected and particularly endangered species and habitats, good ecological and chemical status of non-artificial surface waters and seas, and good chemical status of groundwater bodies · Art. 2, 20a GG · Art. 6, 9, 11, 191 TFEU · EU NEC Directive 2016/2284/EU · EU Air Quality Directive 2008/50/EC · EU Habitats Directive 1992/43/EEC · EU Birds Directive 2009/147/EC · EU Water Framework Directive 2000/60/EC · EU Marine Strategy Framework Directive 2008/56/EC · EU Groundwater Directive 2006/118/EC · EU Nitrates Directive 91/676/EEC · Art. 55 EU Plant Protection Products Regulation 1107/2009/EC · EU Pesticides Directive 2009/128/EC · Art. 5 lit. b) and Art. 6 para. 1 lit. e) Regulation 2021/2115/EU
6c	Protection of the population from hazards and risks to health and property arising from agricultural practices	· Art. 2 GG · Art. 6, 9 TFEU · EU Directive on chemical agents 98/24/EC · EU Framework Directive on Health and Safety at Work 89/391/EEC · EU Plant Protection Products Regulation 1107/2009/EC · EU Pesticides Directive 2009/128/EC · EU Air Quality Directive 2008/50/EC · EU Drinking Water Directive 98/93/EC · EU Bathing Water Directive 2006/7/EC · EU Flood Management Directive 2007/60/EC
6d	Long-term food security for the population with high-quality, safe, nutritious and affordable food and a biogenic supply of raw materials	· A prerequisite for human life and health · Art. 1, 2, 20a GG · Art. 6, 9, 39 TFEU · Art. 5 lit. a) and Art. 6 para. 1 lit. a), d) and i) Regulation 2021/2115/EU · Agenda 21 and Agenda 2030

6e	Permanently high and crisis-proof total yield for cultivated land with the aim of achieving the greatest possible national or European self-sufficiency	· A prerequisite for reducing the vulnerability of national food and feed security as well as biogenic raw materials · A prerequisite for avoiding a shift in negative environmental impacts to other regions and countries (through the relocation of production and compensatory expansion and the intensification of agricultural and forestry use in other regions and countries) · A prerequisite for prioritising combating environmental damage at its source (in this case in relation to consumer demand) · A prerequisite for long-term food security for the population with healthy (nutrient-rich & pollutant-free) and affordable food as well as abiogenic raw material supply · A prerequisite for reducing dependency on imports · Art. 20a GG · Art. 11, 39, 191 para. 2 TFEU · Art. 5 lit. a) and Art. 6 para. 1 lit. a) and b) Regulation 2021/2115/EU
6f	Sufficient and secure income and training for people working in agriculture and forestry	· A prerequisite for equal living conditions in urban and rural areas of Germany · A prerequisite for the acceptance and achievement of sustainable, environmentally friendly (agricultural) land use in cultivated landscapes · Art. 3, 20a, 72 para. 2 GG · Art. 8, 9, 11, 39, 191 TFEU · Art. 5 lit. a) and c) and Art. 6 para. 1 lit. a), g) and h) Regulation 2021/2115/EU · Agenda 21 and Agenda 2030
6g	Reduction of water demand and evaporation in cultivated landscapes	· A prerequisite for climate adaptation in agricultural and forestry · Art. 20a GG · Art. 6 para. 1 lit. e) Regulation 2021/2115/EU
6h	Significant reduction in greenhouse gas emissions from land use (including intermediates goal) by 2030 with the aim of achieving greenhouse gas-neutral agriculture by 2045 or 2050 at the latest	· A prerequisite for achieving climate neutrality in Germany by 2045 and maintaining favourable environmental conditions with less than 2° C global warming · Art. 2, 14, 20a GG · Art. 11, 191 TFEU · European Climate Law Regulation (EU) 2021/1119 · Art. 1 EU GHG target regulation 2018/842/EU · EU LULUCF Regulation 2018/841/EU · EU Energy Union Governance Regulation 2018/1999/EU · Art. 5 lit. b) and Art. 6 para. 1 lit. d) Regulation 2021/2115/EU · Paris Agreement 2015 · UNFCCC · Agenda 21 and Agenda 2030

4 Conclusion

Climate change poses increasing challenges for cultivated landscapes in Germany, with the need to adapt to climate change exacerbated by the existing problems that agricultural land use and other land uses pose for the environment and the people living there. The creation of sustainable cultivated landscapes is indeed a task for society as a whole that extends well beyond the responsibilities and possibilities of individual landowners and farmers.

Society and, in particular, its legislative and administrative bodies will be called upon to set the design framework for the upcoming changes and to implement inter-property measures as well as to steer, coordinate and promote private land use and measures accordingly. Legal, effective and efficient design and management require clear, democratically determined objectives, which in turn must fulfil ecological as well as social and economic requirements.

Based on the overarching premise that the conservation of natural resources on which life depends and favourable environmental conditions are basic prerequisites for life, health, dignity and the exercise of human freedom as well as for the existence of a free and democratic constitutional state, future cultivated landscapes should not only be adapted to the climate, but should also be used in a sustainable and environmentally friendly manner. A series of objectives for landscape design and, in particular, for agricultural and forestry use can be derived from this, which have been defined at the international, European and national level in political strategies, but also in legislation.

The goals and requirements for sustainable and environmentally friendly cultivated landscapes adapted to climate change, that have been set out in this article should form the basis for a social reorganisation of these landscapes and the transformation of their uses. Building on this, in subsequent contributions we will analyse which concrete practical measures are required and how these can be initiated and promoted with the help of regulatory instruments.

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