Climate impact of agroforestry systems

A significant contribution to climate protection

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Background and objectives

The growing urgency of climate change demands stronger action to enhance climate protection. Agroforestry must play a central role as an effective climate protection strategy in land use in the future, as its contribution to achieving climate action goals is essential [1]. Agroforestry systems offer significant potential, as they not only store CO_2 in above- and below-ground biomass and in the soil, but also contribute to promoting biodiversity and positive microclimatic effects, they also improve water and soil protection.

The potential of agroforestry systems

An evaluation of several (inter)national studies on the potential of carbon storage for various agroforestry systems in Europe shows that an average of 10 t $CO_{2\text{-eq}}$ are stored annually per hectare of woodland in the biomass (see Table 1).

In Germany, the roughly estimated sustainable area potential is one million ha of agroforestry. Accordingly, the climate protection performance of agroforestry amounts to 10 million t CO2eq annually – this would correspond to 40% of the 2030 reduction targets set out in the Federal Climate Protection Act 2024. This type of land use therefore provides significant capacity for the successful achievement of climate targets.

Figure 1: A silvoarable agroforestry system in Brandenburg, Germany [1].

Recommended actions and future perspectives

There is currently a large discrepancy between the potential of agroforestry and its consideration in climate protection programs. To overcome this, agroforestry should be recognized as a distinct climate protection measure, its contribution integrated into the objectives, and financial recognition provided.

To better recognize CO_2 compensation, agroforestry systems should be integrated into the carbon market and rewarded through CO_2 certificates in the agricultural sector. This would increase economic attractiveness and create market-based incentives for implementation. Improved value chains for wood, food, and other products could also be beneficial for a wider adoption of agroforestry.

Conclusion

A significant expansion of agroforestry in Germany and Europe could make a significant contribution to climate protection. However, it is necessary to create incentives and remove existing obstacles. This requires close collaboration between politics, research and farmers to create the necessary structures for sustainable implementation.

Table 1: Overview of selected (inter)national studies assessing agroforestry systems with regard to their climate impact [1].

Reduction potential*	Considered areas	Notes	Source
1,8 … 25	▪ C-sequestration in above-/below-ground biomass	▪ Varies depending on tree species, planting density and rotation period	[2]
10,1	▪ C-sequestration in above-/below-ground biomass	▪ Average values from other studies	[3]
5,2 … 21,6	▪ C-sequestration in above-/below-ground biomass	▪ Varies depending on tree species, planting density and rotation period	[4]
10,4	▪ C-sequestration in soil ▪ C-sequestration in above-/below-ground biomass ▪ GHG-reduction by avoiding N fertilization	▪ 9,6 t $CO_{2Äq}$/ha*a regarding biomass growth and soil carbon incorporation ▪ 0,8 t $CO_{2Äq}$/ha*a for GHG-reduction by avoiding N fertilization	[5]
6,0	▪ C-sequestration in soil ▪ C-sequestration in above-/below-ground biomass	▪ Based on a period of 20 years	[6]
1,8 … 5,5	▪ C-sequestration in above-/below-ground biomass	▪ Between 15 and 45 walnut trees for value timber production	[7]
7,0	▪ C-sequestration in above-/below-ground biomass	▪ Referring to the system area: 1,4 t CO_{2eq}/ha*a ▪ No significant increase in soil C compared to grassland reference areas	[8]
19,1	▪ C-sequestration in soil ▪ C-sequestration in above-/below-ground biomass	▪ Referring to hedges and a period of 20 years ▪ 16,0 t CO_{2eq}/ha*a regarding above-/below-ground biomass ▪ 3,1 t CO_{2eq}/ha*a regarding soil	[9]
8,0	▪ CRF methodology of the Federal Environment Agency	▪ 7,94 t CO_{2eq}/ha*a conversion of arable land on mineral soils to woody permanent crops ▪ 9,57 t CO_{2eq}/ha*a conversion of arable land on mineral soils to trees	[10]

* GHG reduction potential in tonnes of $CO_{2\text{-eq}}$ per hectare of agroforestry area and year

Sources:

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