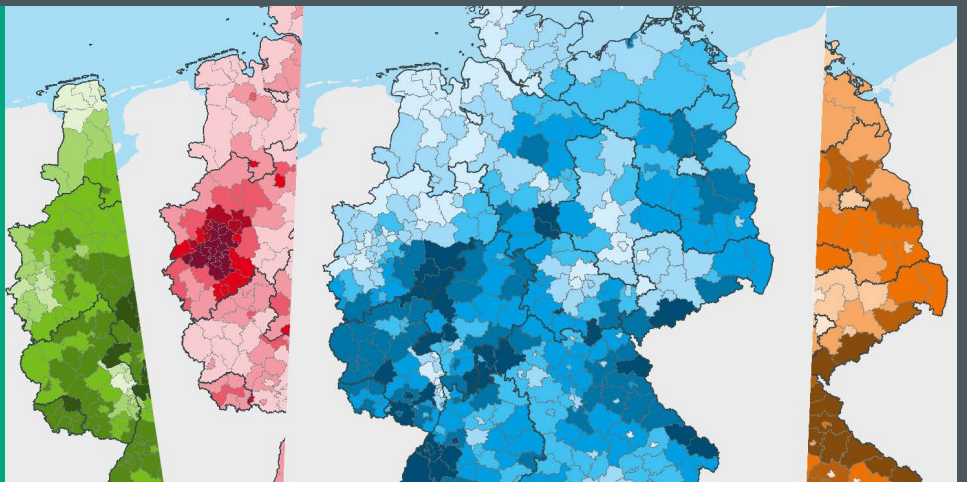


## Thünen à la carte

# *Multitalented forests: climate protection as an ecosystem service*

Margret Köthke,  
Peter Elsasser,  
Martin Lorenz,  
Kerstin Altenbrunn,  
Jürgen Meyerhoff,  
Ulrike Hochgesand  
February 2021



# Multitalented forests: climate protection as an ecosystem service

*Margret Köthke, Peter Elsasser, Martin Lorenz, Kerstin Altenbrunn, Jürgen Meyerhoff, Ulrike Hochgesand*

Timber production, climate and nature protection or recreation: forests provide a wide range of benefits to society, many of them as public goods without a market price. The German Federal Government with its Forest Strategy 2020 aims at integrating the value of these ecosystem services into political decision-making processes – also by using economic valuation. A model of the Thünen Institute now facilitates this.

## REGIONALISING ECONOMIC VALUES OF FOREST SERVICES: THE REWALE MODEL

The ReWaLe model developed at the Thünen Institute can be used to determine and map the values of essential ecosystem services of the forests in Germany according to their spatial distribution. In particular, the model evaluates the monetary benefits of the forests' contribution to global climate protection, of recreational services, of the production of raw wood as well as of services for nature conservation and landscape protection.

The economic value of each of the above-mentioned forest services is determined using a separate valuation function that describes the relationship between the respective service and its value from a demand perspective. The economic impact of possible alternative forest management options on forest services can be calculated in the model. The model, which is implemented in a geographic information system (ESRI ArcGIS), visualises the results at the district level (i. e. NUTS 3) by maps.

## CLIMATE PROTECTION AS AN ECOSYSTEM SERVICE

Forests' contribution to protecting the global climate lies in capturing carbon from the atmosphere through photosynthesis and storing it over the longer term, primarily in the ecosystem. Secondly, this storage can be continued in wood products after harvesting. Depending on the use of the wood, this also replaces carbon-intensive products and processes. In sum, climate-damaging greenhouse gases in the earth's atmosphere are reduced as a result, which would otherwise contribute to further global warming. The aim of the valuation with the ReWaLe model

is to show the value of this primary and secondary mitigation for German society.

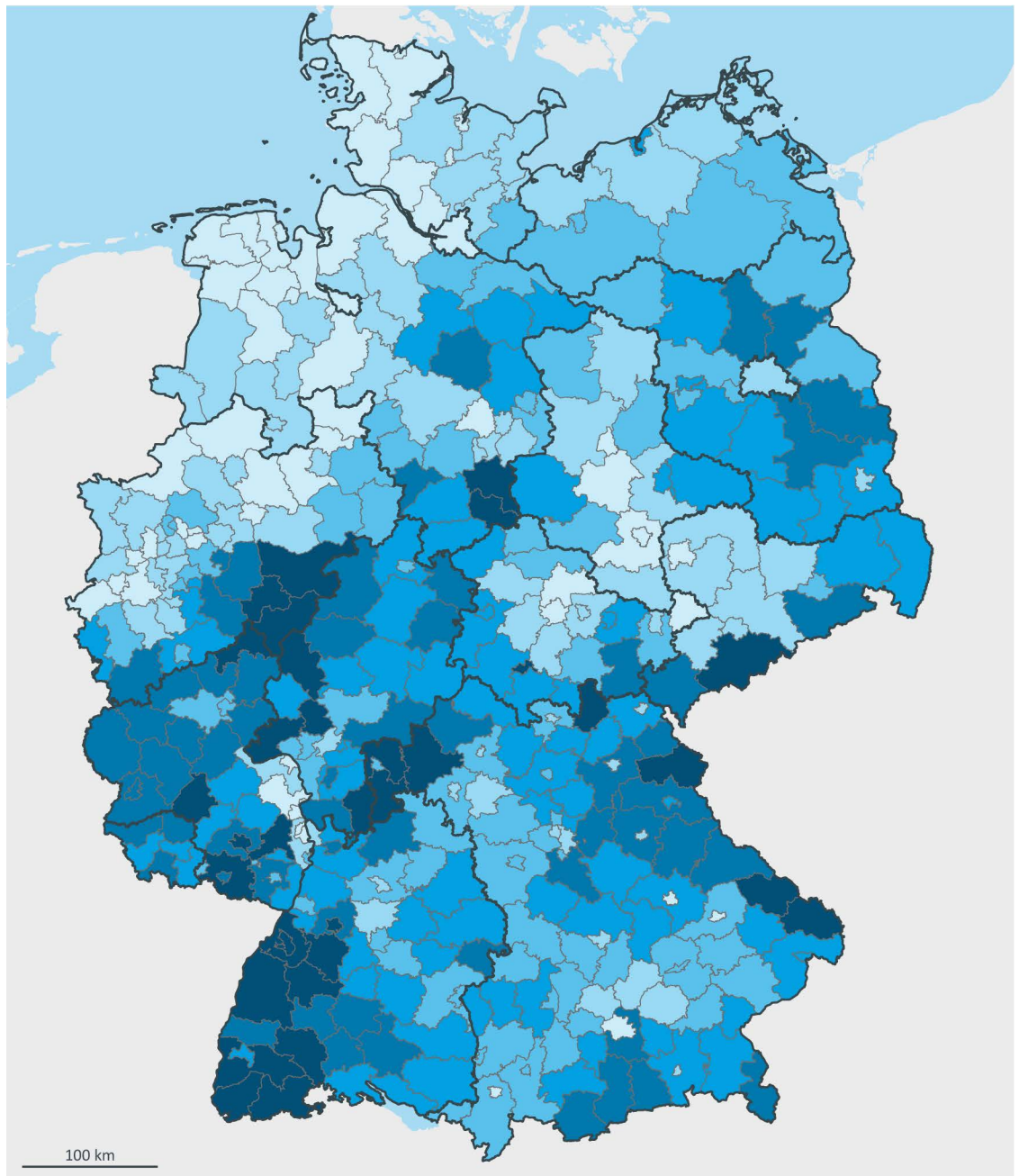
The valuation of the global climate protection service is based on the annual carbon sequestration. In the standard variant of the model, which depicts the status quo, this service is quantified via forest increment and the actual timber harvest according to the 2012 Federal Forest Inventory (BWI). For this purpose, the increase in above-ground tree biomass is extrapolated using various models and the storage in wood products as well as the substitution potentials are estimated (see diagram on page 5). Summing up all municipalities in Germany, this results in a climate protection service of the forests of 108 million tonnes of CO<sub>2</sub> per year. Valued at current prices from emissions trading, the annual benefit of the climate protection service of the German forests amounts to 2.1 billion euros on the basis of the net increment.

Map 1 shows the current distribution of the climate protection service of forests at district level (for timber harvests according to BWI 2012). The level of the climate protection service is largely determined by the share of forest in the respective district, the tree species composition, the age class distribution and the harvest intensity. As Map 1 shows, the annual climate protection service provided by forests in less forested regions in the north and northwest, as well as in large parts of Saxony-Anhalt and Saxony, is less than 4,000 euros per square kilometre. Forest-rich regions with a high proportion of conifers, such as the Black Forest, the Bavarian Forest, the Spessart, the Sauerland, the Harz or the Erzgebirge, achieve the highest monetary values – up to 14,500 euros per square kilometre.

**Map 1:**  
Regional distribution  
of annual climate  
protection benefits in  
1,000 euros per km<sup>2</sup> of  
district area

- ≤ 2
- > 2 to 4
- > 4 to 6
- > 6 to 8
- > 8 to 10
- > 10

Source: Thünen Institute



With the ReWaLe model, scenario calculations can be conducted to show how a change in forest management could affect the ecosystem services of the forests on the ground. For example, Maps 2 and 3 show how the climate protection and raw wood services would change compared to harvests according to the status quo if all the sustainably usable increment were harvested. This scenario results in a 9 percent lower climate protection benefit for Germany as a whole compared to the standard variant, while the raw wood revenues would increase by 17 percent. In most districts, the full use of sustainable forest growth would imply increased felling compared to the status quo. Increased felling would lead to higher raw wood revenues, while carbon storage in the forest would decrease. Even the carbon storage in harvested wood and the substitution effects of increased wood utilisation

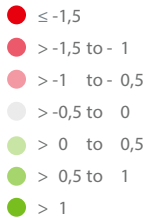
could not compensate for this. In this scenario, the climate protection services provided by the forests would therefore be reduced. Thus, the advantages and disadvantages of a changed logging in the districts are generally opposite between climate and raw wood services.

However, it is also apparent that in 14 percent of the districts (especially in southern Bavaria), the full use of the sustainably usable forest increment would bring disadvantages for both raw wood and climate protection services compared to the status quo.

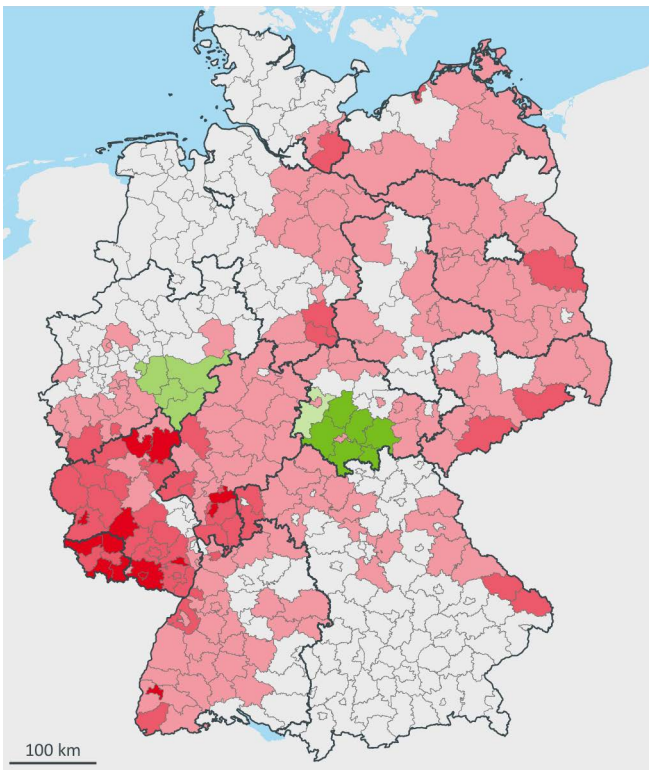
In twelve districts in the Thuringian Forest region and in the Sauerland region, the use of all sustainably usable forest increment

Map 2:

Change in annual climate protection benefits in 1,000 euros per km<sup>2</sup> of district area, if the full sustainably usable increment is harvested, compared to the status quo

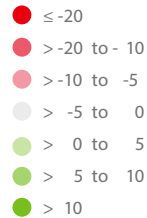


Source: Thünen Institute

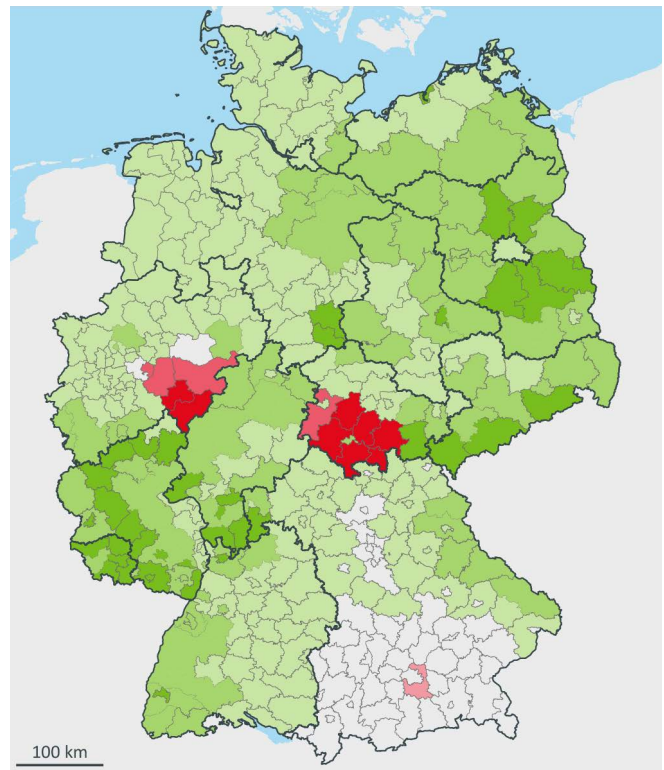


Map 3:

Change in annual raw wood services in 1,000 euros per km<sup>2</sup> of district area, if the full sustainably usable increment is harvested, compared to the status quo



Source: Thünen Institute



would significantly reduce the raw wood benefits (5,000 to 20,000 euros/km<sup>2</sup>), while at the same time significantly increasing the climate protection benefits (up to 1,000 euros/km<sup>2</sup>). This is due to increased timber extraction in these areas. Due to storm damage after the hurricane “Kyrill”, more wood was removed here in the status quo scenario than grows sustainably.

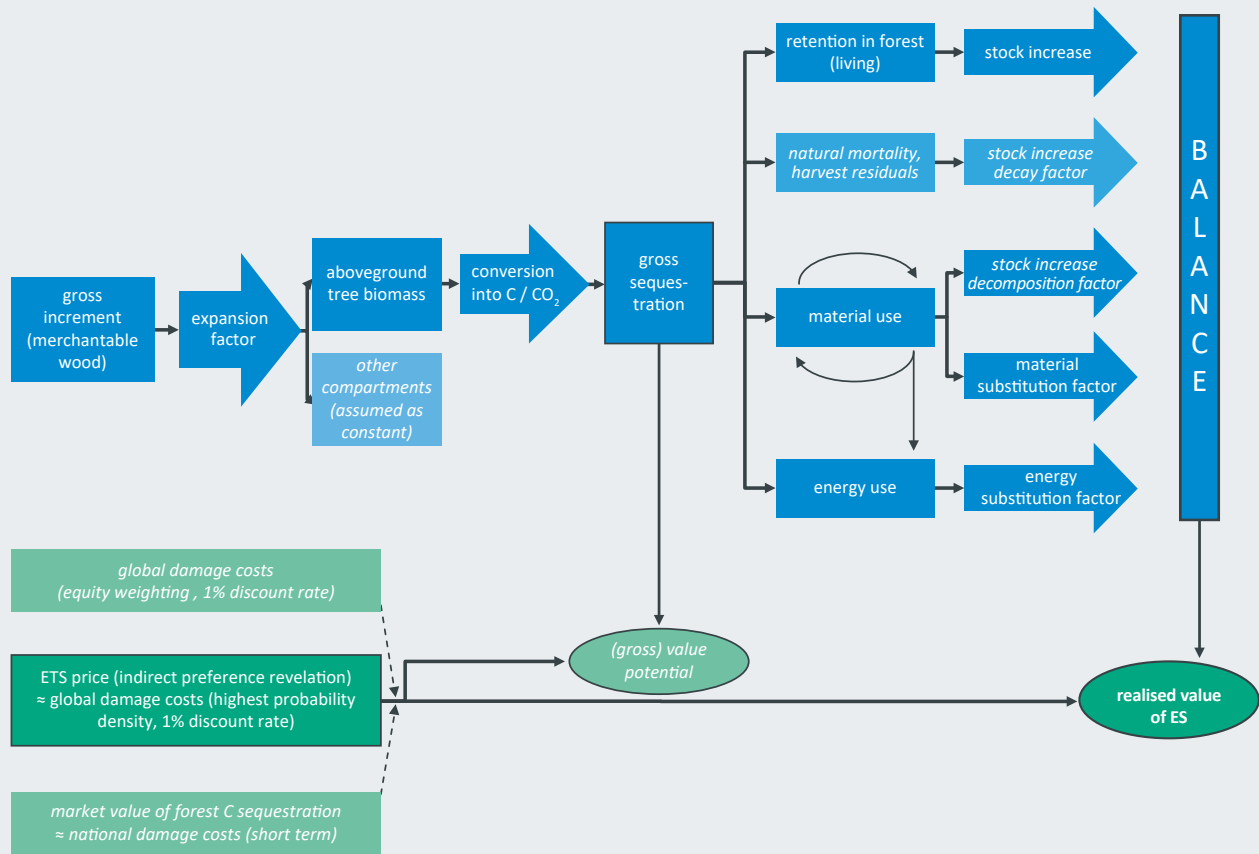
**OUTLOOK**

The results of the ReWaLe model make it possible to systematically compare regional values of different forest services from a pan-economic perspective. With such comparisons, spatial hot spots of services and optimisation potentials can be identified, in order to support forest policy decision-making processes.

(Forest ecosystem services for raw wood production, recreation and nature conservation are presented in further editions of the *Thünen à la carte* series).

For the German government, it is of interest to use the potentials of the forest sector and harvested wood products to meet both national climate protection targets and further voluntary carbon reduction targets. There is an ongoing political discussion about integrating the climate protection service of the forest into a nationwide remuneration system and thus creating incentives for forest enterprises to maintain and, if possible, increase the climate protection service of the forests. For this, it is necessary to know the amount and value of the forests’ climate protection service.

Procedure for determining and valuing the climate protection service



Coarse wood increment (according to BWI 2012) is extrapolated to aboveground tree biomass applying appropriate expansion factors. The carbon stored in the wood is determined on the basis of the volume densities of the different tree species. Depending on the amount of simulated felling, a proportional allocation to different compartments takes place: Part of the wood remains in the forest (living or dead); part is removed and used for material and/or energy. The type of wood utilisation – with different lifetimes and recycling rates – is estimated on the basis of empirical average values. The build-up and depletion of stocks in the forest, deadwood and harvested wood products pools is being balanced. The substitution of energy-intensive materials and fossil energy sources by wood use is taken into account via corresponding substitution factors. (Italics: not taken into account in the standard variant of the model.)

This raises the question of which storage compartments in forests and wood products and which value components should be taken into account. But not only that: After all, how does an incentive system have to be designed in detail to make it work? The ReWale project provides a detailed discussion on the design possibilities of such a remuneration system.

**FURTHER READING**

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Zitationsvorschlag – *Suggested citation:*

**Köthke M, Elsasser P, Lorenz M,  
Altenbrunn K, Meyerhoff J,  
Hochgesand U (2021) Multitalented  
forests: climate protection as an  
ecosystem service. Braunschweig:  
Johann Heinrich von Thünen-  
Institut, 6 p, Thünen à la carte 8 - 2a,  
DOI:10.3220/CA1636635747000**



THÜNEN

**Thünen à la carte 8 - 2a**

February 2021

**Publisher**

Thünen Institute  
Bundesallee 50  
38116 Braunschweig  
Germany

[thuenenalacarte@thuenen.de](mailto:thuenenalacarte@thuenen.de)  
[www.thuenen.de/en](http://www.thuenen.de/en)

ISSN 2363-8052

DOI:10.3220/CA1636635747000

Photos: Thünen Institute, Alrandir - stock.adobe.com

With support from



Federal Ministry  
of Food  
and Agriculture

by decision of the  
German Bundestag