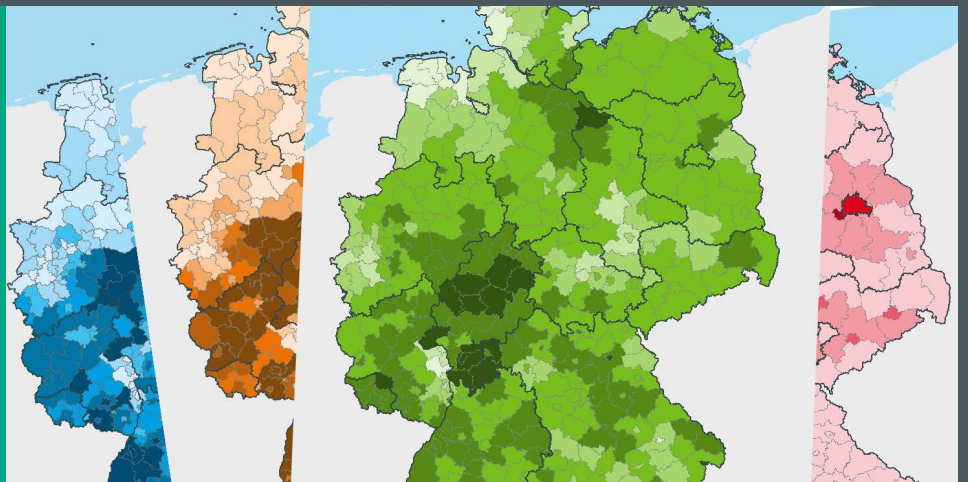


## Thünen à la carte

# *Multitalented forests: nature conservation as an ecosystem service*

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# Multitalented forests: nature conservation as an ecosystem service

*Jürgen Meyerhoff, Peter Elsasser, Kerstin Altenbrunn, Martin Lorenz, Margret Köthke, 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 services for nature conservation and landscape protection, of forest recreation, of the forests' contribution to global climate protection, as well as of raw wood production.

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 the demand's point of view. The economic impacts of possible alternative forest management 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.

## ECOSYSTEM SERVICES FOR NATURE AND LANDSCAPE

Several indicators describing the state of nature and its changes were used to value the services for nature and landscape. One of them measures species diversity in forests, in this case in terms of the number of characteristic forest birds. A choice experiment was used to determine how much people in Germany would value higher forest biodiversity (see diagram on page 5). Based on the estimates derived from the choice experiment, it was possible to calculate a scenario that shows the willingness to pay (WTP) for the

restoration of the original biodiversity in the individual districts. It adds up to about one billion euros per year for Germany as a whole.

Looking at the WTP distribution across districts (Map 1), those with negative WTP stand out first, especially around the Vogelsberg region and in the Odenwald. In these districts, the original species diversity was probably lower than it is today. A restoration of the original state would therefore result in a reduction of species diversity in these districts. The negative WTP shows the losses that a reduction in biodiversity would entail.

In most parts of Germany, the WTP for an increase in forest biodiversity ranges from about 20 euros to almost 80,000 euros per square kilometre of district area per year. Especially in north-western Germany, the WTP is quite high – everywhere where forest biodiversity is low today and/or population density is high: in the Ruhr area, along the North Sea coast, along the Rhine corridor, from the foothills of the Erzgebirge along the Leipzig lowland bay up to the Magdeburger Börde and also in the southern half of Bavaria. In addition, some cities stand out where a high WTP is mainly due to high population density rather than low biodiversity.

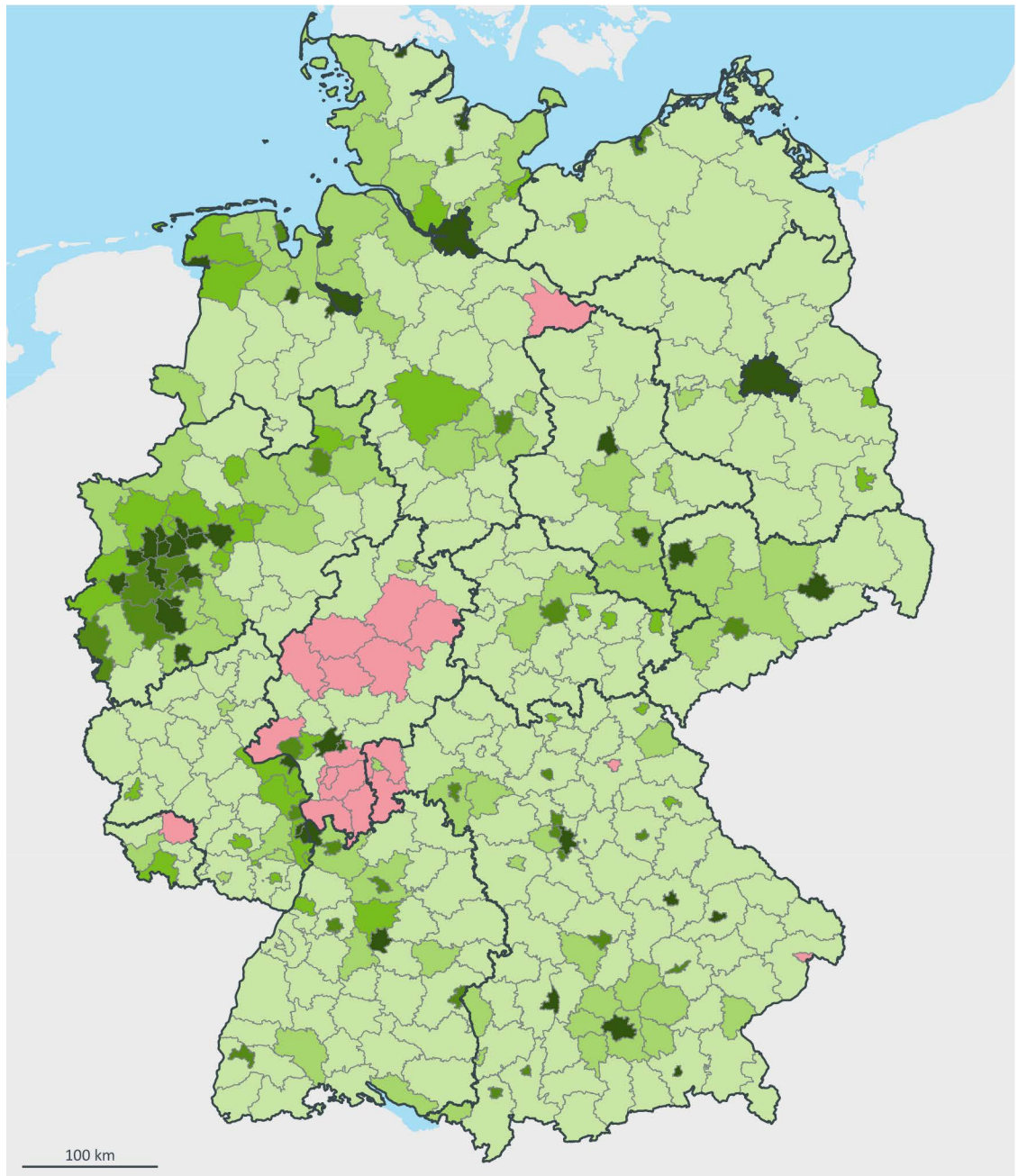
The choice experiment also provides information on the WTP for different proportions of deciduous, coniferous and mixed forest. The tree species ratio is discussed as an important parameter in nature conservation; changes would also have an influence on perceived landscape beauty. In order to test the effects of an increase in the proportion of beech, for example, a scenario was



**Map 1:**  
Spatial distribution of annual WTP for restoring the original biodiversity in the forests, in 1,000 euros per km<sup>2</sup> of district area

- ≤ 0
- > 0 to 2
- > 2 to 5
- > 5 to 10
- > 10 to 20
- > 20

Source: Thünen Institute



calculated with the ReWaLe model in which the proportion of beech in the forest area is increased by 10 percentage points in all districts.

In this scenario, the long-term raw wood revenue potential of currently 6.8 billion euros decreases by 300 million euros annually. Climate protection benefits also decrease slightly, from the current 2.11 billion euros by 10 to 20 million euros per year. In contrast, the shift in the tree species ratio leads to overall gains on the side of nature and landscape: by a good 130 million euros annually in total.

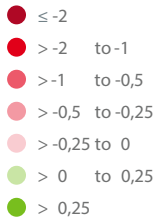
The individual regions of Germany are affected very differently by these changes. Losses of raw wood potential occur in the vast

majority of all districts (Map 2). The spruce-rich low mountain ranges are most affected, including the Rhenish Slate Mountains and the Black Forest. Only seven districts show gains. All of them are located in very sparsely forested areas of eastern Germany. The change in the climate protection service follows the same regional pattern – albeit at a lower level.

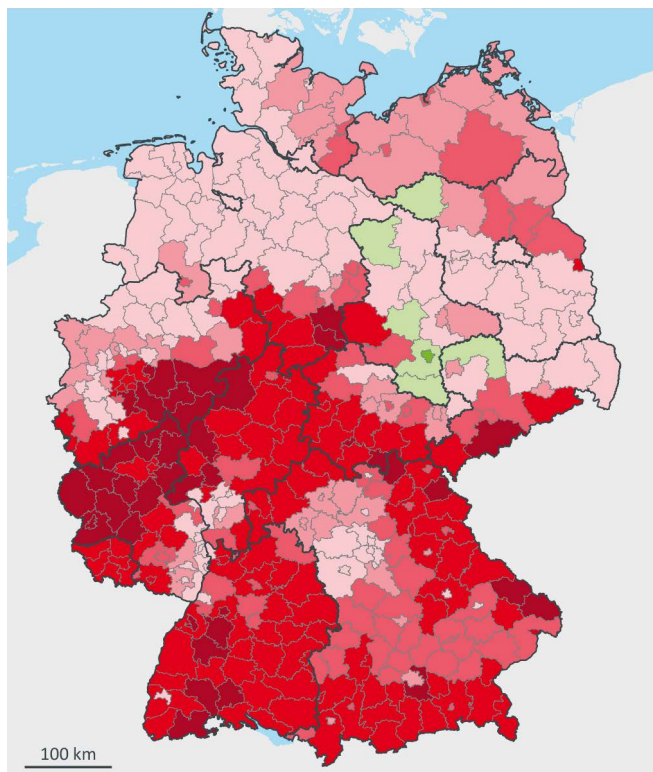
The WTP for 10 percentage points more beech than in the status quo is also distributed very unevenly across the regions (Map 3). About half of all districts show positive values. These districts are mainly found in the coniferous forest-rich east and south of Germany. In addition, some urban districts stand out with particularly high values of over 5,000 euros per square kilometre annually. The high values are mainly due to the high population

Map 2:

Change in annual raw wood potential with 10 percentage points more beech than in the status quo, in 1,000 euros per km<sup>2</sup> of district area

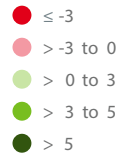


Source: Thünen Institute

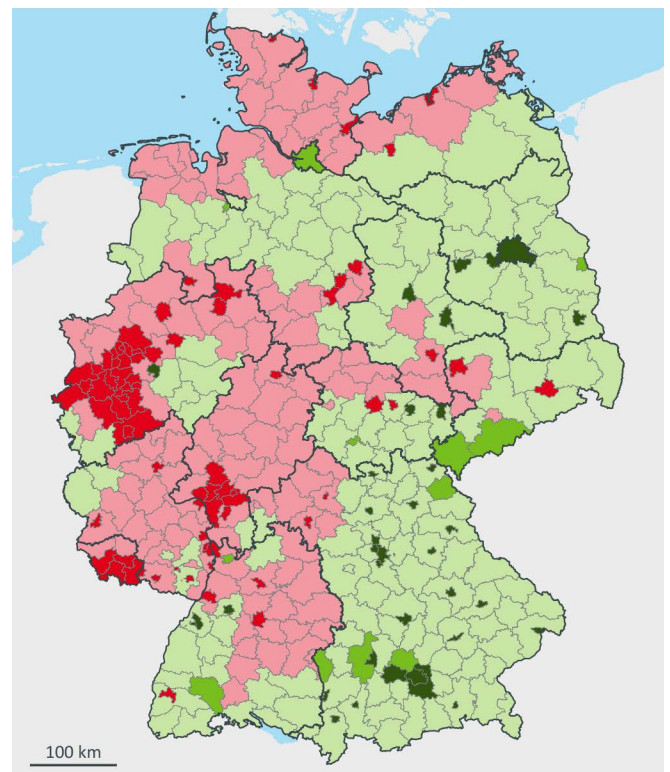


Map 3:

Annual WTP for 10 percentage points more beech than in the status quo, in 1,000 euros per km<sup>2</sup> of district area



Source: Thünen Institute



density. In contrast, in the other half of the districts, a further increase in the proportion of beech trees is valued negatively. This is because the proportion of deciduous trees there is already high: Around a third of these districts record losses of more than 3,000 euros per square kilometre of district area per year as a result. Negative values in the map are to be interpreted as a WTP for an increase in the proportion of conifers.

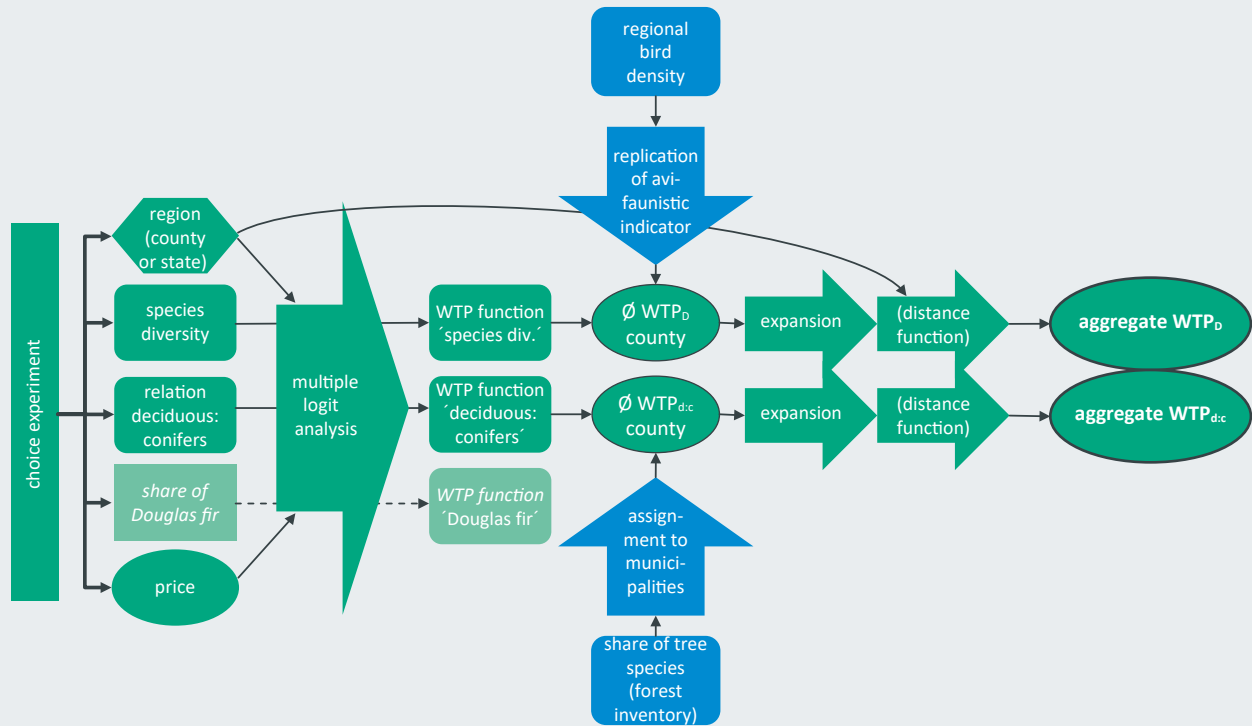
Looking at the results for raw wood production, climate protection and for nature conservation and landscape together, gains and losses usually turn out to be antagonistic: districts where the higher proportion of beech reduces raw wood yield potential and climate protection gain by their improved biodiversity and landscape beauty, and vice versa. However, this is not always the

case; some districts lose in terms of all three ecosystem services. Examples of this can be found especially in the Rhine-Main region. Only for very few districts (in the north-east of Germany) the result would be entirely positive.

### 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, climate protection and recreation are presented in are presented in issues 8-1, 8-2

**Procedure for identifying and valuing services for nature conservation and landscape protection**



In a representative population survey throughout Germany, a choice experiment was used to estimate, among other things, the individual WTP for changes in forest biodiversity and tree species composition. This was used to statistically derive WTP functions for species diversity and for the ratio of deciduous trees to conifers, and linked to regional data on breeding bird density (as an indicator of species diversity) and the regional tree species ratio. This allows average WTP to be calculated for each district; in order to extrapolate to the population, these are multiplied by the number of inhabitants in the individual districts. In scenario analyses, the values calculated for the respective scenario are compared with the current situation.

and 8-3 of the series *Thünen à la carte*). The remuneration of forest ecosystem services is currently the subject of much debate. Our results from the ReWaLe project show in which regions such incentives are particularly advantageous from the perspective of society as a whole, and in which other regions it would be better to do without them.

**FURTHER READING**

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