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Building “without land take” – current state of land take in Germany

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Building “without land take” – current state of land take in Germany

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Abstract. Based on the United Nations Agenda 2030 the government of Germany has formulated a national sustainability strategy which seeks to mitigate the ongoing increase in land take and aims for a circular economy until the year 2050 instead. Despite these political efforts, more land has been converted to building land in recent years. As part of a recent research project at Hamburg University of Technology, a preliminary study on land-take in Germany has been carried out as first milestone.

Drivers of land take in recent years have been the regions of north-eastern, western and south-western Germany, while in centre regions a notable decrease in daily land take could be observed. The northern metropolitan areas mostly reported decreasing rates in their urban centres while land take increased in their suburban and greater areas. In contrast a densification of urban centres could be observed in the southern regions, while the surrounding rural areas showed decreasing or neutral trends. Only few counties reported a consistent negative land take over the recent years. Additional findings indicate that land take came almost exclusively at the expense of agricultural areas. In combination with recent efforts of afforestation backed up by comprehensive environmental protection laws, the available arable land quickly decreased over the recent years.

To challenge this ongoing problem, the research project takes a novel approach on the design of large-scale commercial real estate by combining these buildings with commercial agriculture. A project outline is given at the end of the paper.

1. Introduction

In September 2015, the member states of the United Nation agreed upon the 2030 agenda for sustainable development [1]. The agenda suggests 17 sustainable development goals (SDGs) which – among other objectives – seek to make cities more resilient and sustainable as well as halt land degradation and biodiversity loss.

Based on these fundamental goals, the federal republic of Germany has adopted a national sustainability strategy [2], building upon the Agenda 2030 SDGs by concretizing and linking them with quantifiable indicators. Associated with SDG No. 11 “Make cities and human settlements inclusive, safe, resilient and sustainable”, the indicator “Land take for settlements and transport infrastructure [hectares/day]” establishes two connecting goals: Reduction of the

daily increase of land take to 30 hectares/day until the year 2030 and establishment of a circular economy (“net-zero land take”) until the year 2050.

The topic has gained additional momentum in the face of a new soil monitoring law recently proposed by the Council of the European Union. So far, a general approach has been published [3], highlighting the importance of mitigating land take and the associated sealing/ destruction of soil towards the goal of a healthy and sustainable soil management system by the year 2050.







In this context, a new research project has been brought to life at Hamburg University of Technology which aims to potentially reconcile the conflicting objectives of land take mitigation and the ongoing demand for building land in the context of large-scale commercial real estate. In order to assess the status quo, a preliminary study on the recent trends considering land take in Germany has been conducted, as presented in this conference paper. Additionally, a brief project outline is given at the end.

2. Method

As a starting point, publicly available data on land use provided by the federal statistical offices of Germany have been analysed. These data sets contain detailed information on land use on the federal and county level and are collected and updated on a yearly basis, thus allowing for an in-depth analysis of regional trends and disparities.

The evaluation of land use data follows the same principles that are applied to monitor the sustainability factor “Land take for settlements and transport infrastructure” [4], which encompasses all developed and undeveloped areas characterised by human usage, excluding extraction areas. In order to evaluate local trends in section 3.2, the moving four-year-averages of the years 2016-2022 were calculated and then analysed using the criteria given in Tab. 1. The results have then been made visible on a map showing Germany’s county borders and major metropolitan areas using a simple colour code in fig. 2.

Table 1. Criteria to evaluate land take rates in section 3.2

designation	strong increase	slight increase	neutral	Slight decrease	Strong decrease	negative
Change in land take rates	Land take more than doubled	Land take more than 30 % higher	Land take not more than 30 % higher/ lower	Land take more than 30 % lower	Land take more than halved	Land take consistently negative
Colour coding						

Acquisition of land use data is based on land-registries of the German federal states. Minor internal statistical inconsistencies arise from different local interpretation of object type definitions and minimum coverage sizes. Furthermore, data is subjected to change because of subsequent re-measurements and recordings, which is the reason why the results in section 3.1. of the conducted study deviate from the ones published in official reporting. A fundamental methodical shift took place in the year 2015, as data collection was no longer based on property registers but instead on real geometric dimensions. This led to changes in recordings without real adjustments to the landscape [5]. As a result a comparison to earlier data is impaired and thus left out in the conducted study.

3. Results and discussion

3.1 Land take on federal level

Land take data, aggregated on the national level, is shown in accordance with the latest official report on land take [6] in Fig. 1. The original figure has been slightly adjusted to also differentiate between housing/ public facilities and industry/ commerce.

**Land take for settlements and transport infrastructure
[hectares per day]**

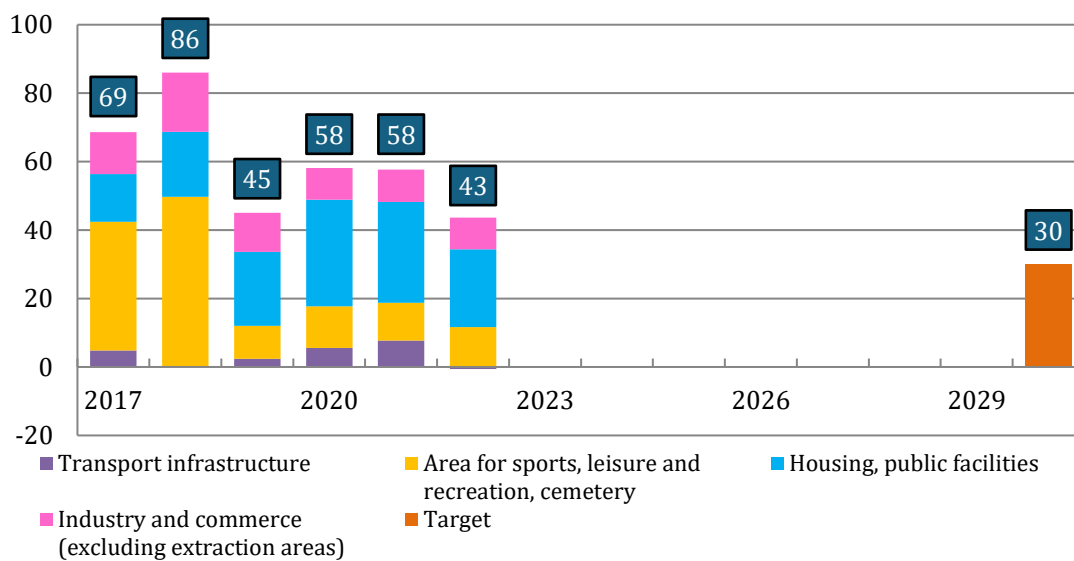


Figure 1. Recent land take for settlements and transport infrastructure in Germany, study based on latest available land-use data provided by the federal statistical office [17]

While a general downward trend towards the overarching goal to reduce land take to less than 30 hectares per day can be confirmed, the bar chart shows a higher land take in the years 2017 and 2018 compared to official reporting [6], most likely because of subsequent re-measurements as presented in section 2. According to these figures, this additional conversion of land seems to have been mainly in favour of area for sports, leisure and recreation. The average daily land take for industry/ commerce has stagnated over the period under review, while areas for housing and public facilities remain the most important driver for land take.

3.2 Land take on county-level – latest trends and regional disparities

To get a more detailed view on the current trends and regional drivers inducing land take, an analysis of land take rates in recent years has been carried out on the county level, as shown in fig. 2. The original hypothesis, stating that land take would occur mainly in metropolitan areas and their urban and suburban areas, could generally not be verified. Instead, the northeastern and southwestern regions were indicated as drivers of land take in recent years, despite their rural characteristics and partly shrinking population [7]. While the metropolitan areas of Berlin/ Brandenburg, Rhine-Ruhr and the northwestern area show increasing land take rates, most other metropolitan areas saw neutral or even decreasing rates. Notably in southern Germany, land take concentrated mostly in urban areas, whereas it spread into more rural

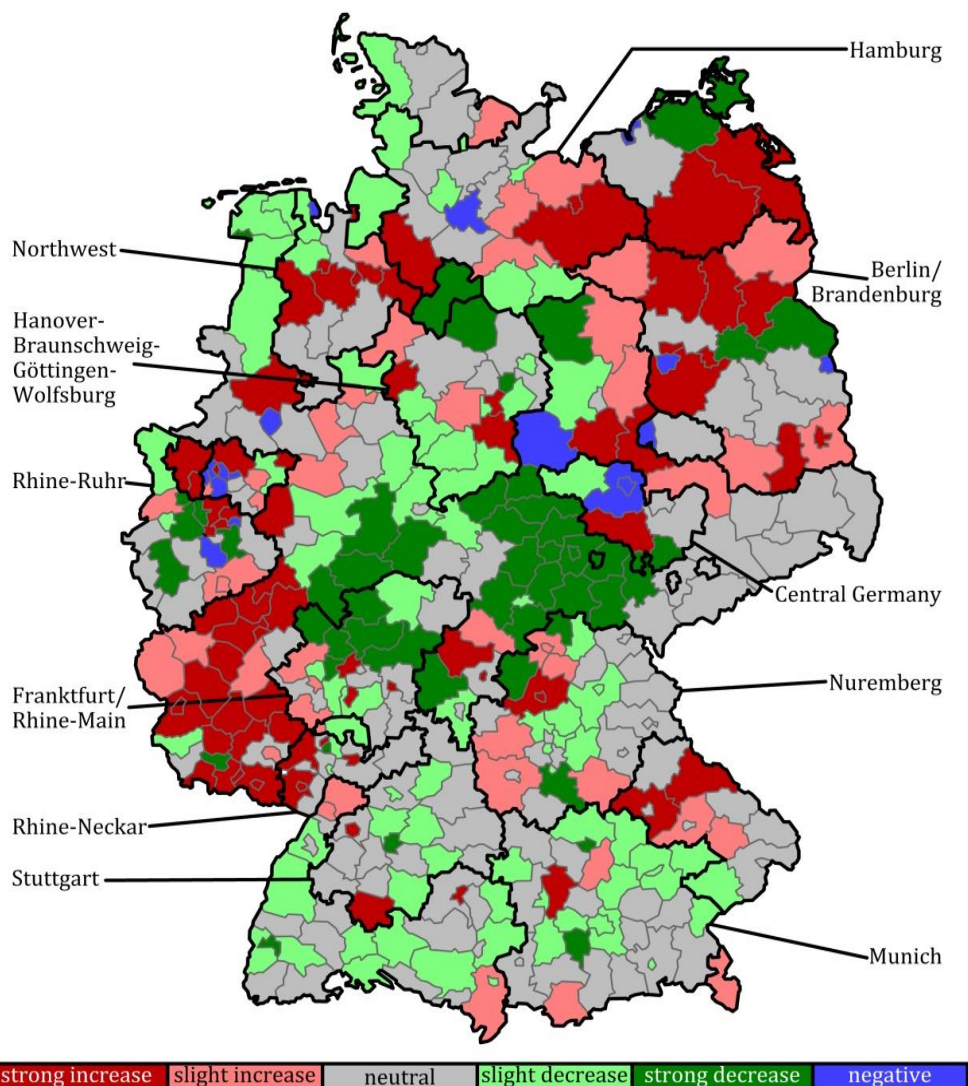


Figure 2. Trends of land take rates in recent years by county/ independent cities; the eleven major metropolitan areas are highlighted by thick borders; data provided by the individual state statistical offices [22]

counties in the north and west. The regions reporting the lowest land take are located in central Germany, consisting of the counties of the federal states of Hesse and Thuringia. These show a strongly decreasing rate of land take, many even indicating a negative trend in the most recent years. However, only a few counties and independent cities reported a consistently decreasing land take over the reviewed period; these are highlighted by a blue colour.

3.3 Effects on agricultural and forest areas

Land is a limited resource which cannot be created nor destroyed, only repurposed. This means that the aforementioned land take has to go hand in hand with a decrease of other land-uses. The development concerning the two most important categories, agricultural and forest areas, are shown in fig. 3. By comparing these numbers to the ones in fig. 1, it becomes clear that land take corresponded by a large margin with the loss of agricultural areas. Additionally, a notable increase in forest areas could be observed which likely accelerated the decrease of arable land.

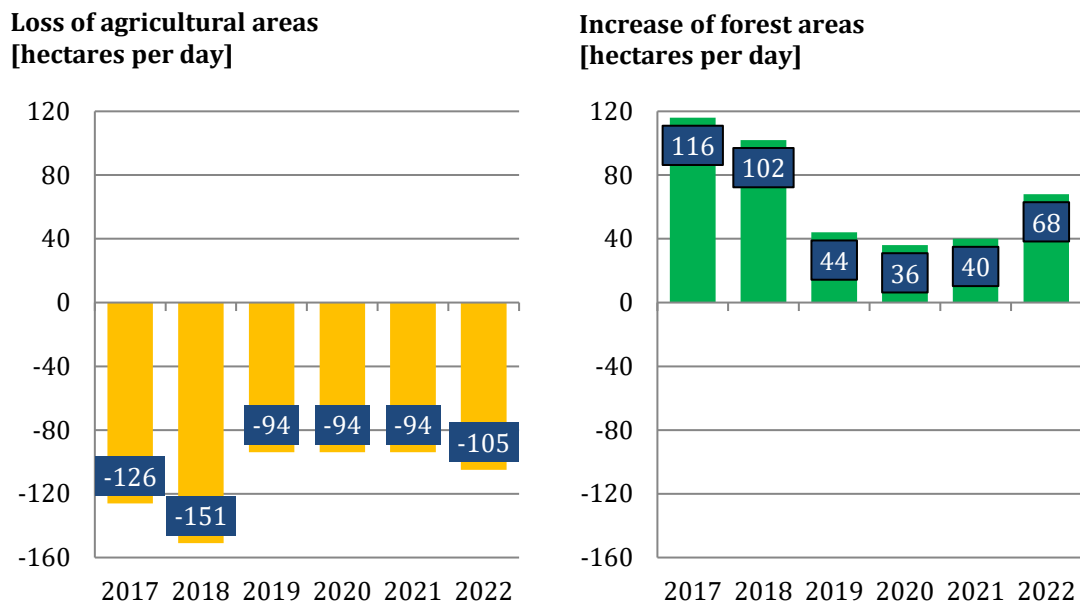


Figure 3. Recent changes in agricultural and forest areas in Germany, study based on latest available land-use data provided by the federal statistical office [21]

This observation corresponds to the findings of other studies [8, 9], whose authors report a significant loss of agricultural land in favour of other competing uses: settlement and transportation, energy infrastructure and natural preservation.

3.4 Legal framework surrounding land take

Considering land take, the most important legal field is the one of spatial planning. In Germany, there exist three main levels of planning which are based on the vertical government structure as a federal state (see fig. 4). One the federal and state level, spatial planning acts are issued, which determine the overarching goals concerning land take. In the course of the study it became clear that the overall intention to reduce land take for settlements and transport infrastructure have been thoroughly implemented into most spatial planning acts. It is commonly stated that the designation of additional building land should be minimized, instead measures of internal development of already existing areas are promoted, such as densification of urban areas, repurpose of existing infrastructure and recycling of fallow land. However, these goals often remain unspecific, since the federal goal to reduce land take to below 30 hectares/day by 2030 is often not yet further broken down and integrated into state planning acts. So far, only a few federal states have agreed on concrete target numbers: Land take in Bavaria shall be reduced to 5 ha/ day [10], in Lower-Saxony to 3 ha/ day [11] and in Schleswig-Holstein to 1,3 ha/day [12], all by the year of 2030. In other federal states, concrete target numbers are instead stated as part of coalition treaties (e.g. Baden-Württemberg: 2,5 ha/day and circular economy until the year 2035 [13]; Rhineland-Palatinate: land take permanently under 1 ha/day [14]).

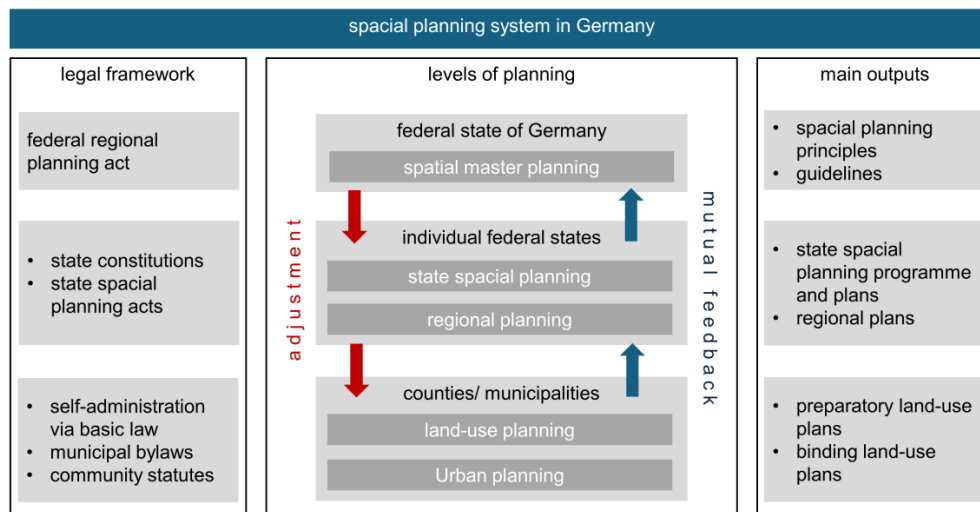


Figure 4. Overview of the special planning system in Germany

The bottom level of spatial planning is executed on the county and municipal level, where regional plans are further concretized into land use and local development plans. This has a crucial impact on land take, since municipal authorities are on the one hand bound by these federal laws, but on the other hand enjoy a substantial freedom concerning their self-administration, which is constituted by the German Basic Law [15]. This includes, among others, the sovereignty to shape local development – and ultimately to take and reallocate land.

An observation from literature about residential land take is that spatial planning policies alone can have a dampening effect on but are usually not enough to effectively reduce land take [16]. Additional regulation comes in the form of local stakeholders interested in protecting the environment. This however is offset by economic interest, since municipalities heavily rely on local taxes, which in turn leads to them competing over potential residents and companies [17].

In addition to the legal sector of spatial planning, land take is also affected by many different environment protection laws, often implying conflicting goals and objectives. Important in relation to the conducted study are the federal laws towards the conservation of forest and promotion of the forestry sector [18], which offer additional protection against their claim for building land. This is further supported by the German national forest strategy 2020 [19] which emphasizes sustainable forest management. While there is a similar German agricultural strategy 2021 [20], which in particular acknowledges the recent decline of agricultural areas in favour of settlement and transportation areas as a driver for rising competition among farmers and thus skyrocketing prices for farmland, there is no corresponding comprehensive legislation, yet.

4. Conclusions and significance

The conducted study gives a deeper insight towards the recent development of land take in different regions of Germany. While the overall trend towards the national goal of a land take below 30 hectares/ day could be confirmed, a more in-depth study on the county level revealed more differentiated regional developments in urban and rural areas. In addition to the ongoing increase of settlement and transportation areas, the conducted study also put the corresponding changes in agricultural and forest areas into perspective. While it is not possible to directly

assign the growth and loss of specific areas to each other; the overall trends are clear – the ongoing increase in areas for settlement and transportation combined with recent efforts for environmental protection legislation and demands for provision of renewable energy result in dramatic losses of agricultural area. These in turn lead to rapidly rising land prices and increased competition among farmers, worsening their often rough economic situation even further. While there are legal and political efforts towards a more sustainable development being made, they generally do not seem to be sufficient to induce a much-needed change. Especially on the municipal level, there seem to be too few concrete tools that not only ensure a more sustainable and space-efficient local development but also provide economic incentives for companies and local stakeholders alike.

5. Project outline: “Building without land take – rethinking commercial real estate”

As a potential answer to the resulting problem of ongoing demand for industrial and commercial land at the expense of agricultural area the research project with the working title “Building without land take – rethinking commercial real estate” has been brought to life at Hamburg University of Technology. The scope of this project is shown in fig. 5. The preliminary study, as laid out in this conference paper, is part of the first work package “land take: status quo”.

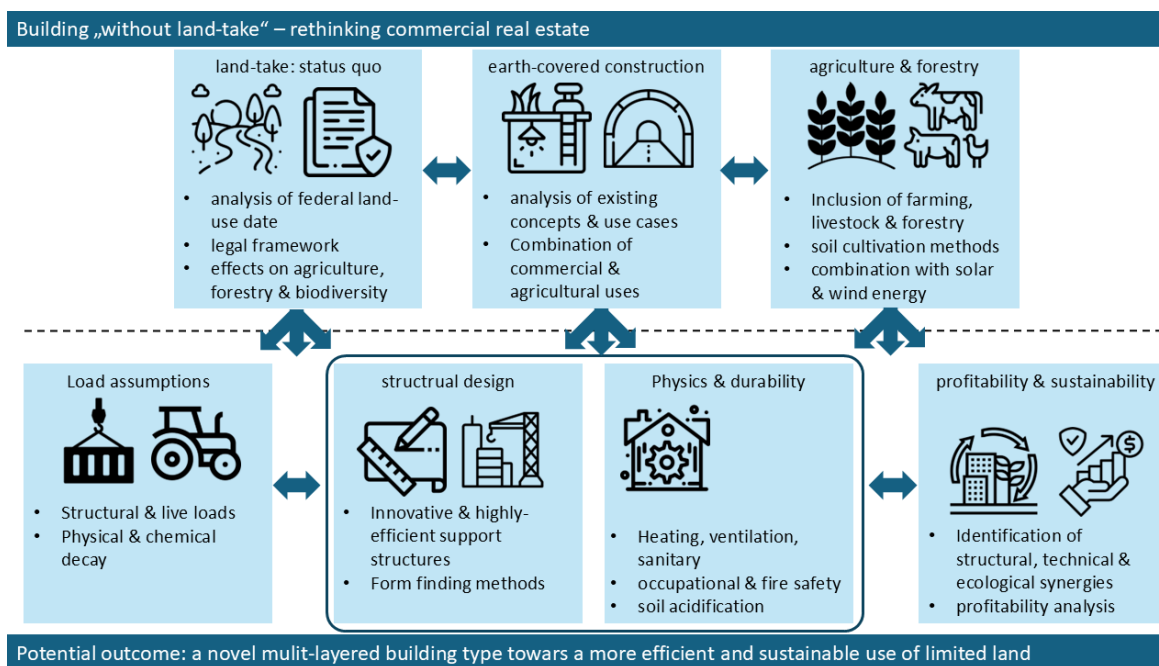


Figure 5. Project outline: “Building without land take – rethinking commercial real estate”

Most of the in section 3.4 briefly described measures to reduce land take by prioritizing internal development of municipalities, such as densification or repurpose of existing urban areas are not applicable to large-scale commercial real estate, such as logistics centres, storage facilities or industrial sites as they usually require large open areas due to their size and scope. As a result, these buildings account for a large proportion of land take, mostly at the expense of agricultural land as discovered by the preliminary study.

The underlying idea behind this project is to combine these buildings with agricultural use by either bringing them (partly) underground or by making their rooftops suitable for intensive

arable farming. This novel approach encompasses not only the development of unique and precisely fitting load-bearing structures, but also new technology and energy concepts. It is expected that the initial higher construction costs can be offset by different advantages of earth-covered construction methods (e.g. better insulation and water usage) and taking advantage of synergies between renewable energy sources and farming (e.g. solar panels and wind turbines), which will be verified by a profitability study. The potential outcome of the research project will be a novel multi-layered building type capable of a more resource efficient and sustainable land-use, making a notable contribution to the overall efforts of reducing the otherwise substantial land take for conventional commercial buildings.

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