

Vida Maliene, Reinfried Mansberger, Jenny Paulsson, Tine Köhler,  
Walter Seher (eds.)

# Sustainable and Equitable Land Management

## Legal Framework, Assessment, Planning Tools

EUROPEAN ACADEMY OF LAND USE AND DEVELOPMENT

EUROPÄISCHE AKADEMIE FÜR BODENORDNUNG

ACADÉMIE EUROPÉENNE DES SCIENCES DU FONCIER

**v/alf**

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# Introduction

The European Academy of Land Use and Development (EALD) takes a multidisciplinary approach to sustainable land management. The members of EALD are scientists of different disciplines from European universities and independent research institutes.

EALD organizes annually a scientific symposium on a specific topic. A far-reaching expertise of the participating members and guests allows a comprehensive and transdisciplinary view of the respective topic to be discussed. The research presented at the symposia is subsequently published in a book format.

The current book includes scientific articles based on the research presented at two recent EALD-symposia. In 2021, the symposium was held at the University of Natural Resources and Life Sciences Vienna (BOKU) on the topic “Sustainable Land Use and Development: Planning and Monitoring” with a focus on planning and monitoring aspects for sustainable land use and development considering an interdisciplinary context. The presentations covered a range of land management issues, such as legal frameworks, economic and environmental aspects, administrative arrangements, formal and informal instruments of land management, as well as methods of data collection and data provision. In 2022, the symposium held at the Frankfurt University of Applied Sciences (FRA UAS) was dedicated to the “Ecological, social and spatial justice”. It addressed the spatial justice, the impact of land management measures issues, and competing objectives of environmental and social equity.

Each article included in this book has been peer-reviewed by two experts. Additions, improvements and corrections suggested by these reviewers enabled the authors to improve their articles. Due to the very broad interdisciplinary nature of this book, the articles were also evaluated by the experts in the relevant fields.

The articles are arranged thematically by the editors of the book. The first part covers the legal framework, organisation and evaluation of land management. Planning and administration systems, land development processes, and land resource management assessment and other case analyses are presented in the articles from Austria, Estonia, Lithuania, Latvia, Sweden, and Norway.

- *Auziņš, Viesturs and Romanovs* discuss in their article the land management practice from the perspective of spatial development planning and the policies related to land resources and their preservation. The legal framework for the use of land resources has been analysed in the context of spatial development planning in Latvia. Also, the study introduces and describes, the Land Resource Management (LRM) assessment model, developed by the authors, which allows to assess the effectiveness of LRM by looking at the performance indicators characterizing national level land management goals and comparing the changes in these indicators under the influence of different management arrangements. This model is essential to promote effective and science-based land resource management (LRM), also it is an important tool for policy makers to assess



how land-related resources are managed. The developed model has been tested to provide the evaluation results of land resource management in five European countries: Austria, Estonia, Latvia, Lithuania, Sweden.

- *Dyrkolbotn* and *Røsnes* examine the spatial planning in fragmented national planning systems by using the case of Norway. They claim that building and planning acts hardly provide a complete understanding of the planning system since it depends also on the territorial and the material scope of the legislation currently in force. They show that such disconnections also appear in the Norwegian legislation for spatial planning and that the national legal system for public spatial planning consists of variants and even sub-systems.
- The article by *Dyrkolbotn*, *Leiknes* and *Røsnes* highlights the particularities in the Norwegian planning and cadastral systems concerning planning responsibilities, the provision of land for development, as well as property formation and registration. They describe the roles of the local planning authorities and the developers' responsibility in the planning system and property formation and conclude that the public process goes back and forth depending on the acquisition of land and how ownership of the constructions can be transferred according to the cadastral rules.
- *Ekbäck* discusses institutional transitions in the land development domain. He shows that prevalent theoretical models concerning institutional development and change can be classified into two opposing traditions depending on whether they perceive legislation as allocative (value-enhancing) or redistributive in nature. By two case studies, concerning legal reforms in Swedish legislation on land development, he evaluates the explanatory and predictive capacity of these theories, where the concept of path dependence is an important factor.
- Insights on the Norwegian system are provided by *Leiknes*, *Mjøs* and *Røsnes* to interpret the development of a cadastral system where land information is encumbered with inaccuracies and flaws. The investigations are directed at the basic surveying, mapping and registration of real property, the technological modernisation process, and the organisation of this process. They indicate shortcomings within all these components for developing a cadastral system, such as the impact of special interests and the fragmented and contradictory organisation of attempts to modernise the system.

The second part of the book focuses on the sustainability in land management. The articles examine examples of the sustainability assessment in land management, and also address the question, “whether the current methods used to assess the sustainability in land management are sufficient and accurate?”

- *Evers'* article discusses the sustainability aspects of urbanisation in Europe since 2000. In respect of the relatively new EU initiative “no net land take”, which is essentially calling for a halt to urban development, the analysis of urban developments towards achievement of this goal across European countries, have been made. The reflection of

conducted analysis concludes that the magnitude and velocity of urbanization (land take) is certainly important, but also how this urbanization takes shape, as this will powerfully affect car-dependency, service levels and energy efficiency.

- *Köhler* and *Hepperle* argue that sustainability should be the main goal of land management and therefore the sustainable development goals should be balanced for public welfare. This article focusses on discussion how land management could learn from the immune system as the immune system aims to keep people healthy, which refers to sustainability. The discussion concludes: “If we can ensure that the weighing of interests in spatial planning is based on facts and on the requirements of justice geared to the specific spatial conditions, and if we also move away from hierarchical and responsibility-oriented thinking, then land management has a real chance of being fit for the future. The interesting thing about this is that it is much more a question of approach than of fundamental legislative revision.”
- The article by *Mengi* and *İşçioğlu* presents an evaluation of land use decisions in mining activities in Turkey within the context of economic, social and ecological sustainability. The authors claim that political powers adopt economic priorities instead of environmental protection and fail to manage the Environmental Impact Assessment (EIA) process when making land use decisions. Since this process is often taken to administrative courts due to its problematic functioning, environmental damages may occur until the results are obtained.

The analysis, techniques and scenarios to support decision making in land management are documented in the third part of the book. The described techniques are suitable to obtain information about future needs, interrelationships and dependencies of processes, based on case studies in the fields of land consolidation and spatial planning.

- *Bretscher* and *Linke* present a scenario technique to identify future land management requirements. Using the example of the redesign of land consolidation processes in Germany, the authors outline various basic techniques for creating scenarios, provide information on why scenarios are used and for what purpose, and derive optimal methodological steps for the presented research on the redesign in land consolidation procedures. Since the complexity of redesign and the number of land consolidation tasks will increase, the authors recommend providing sufficient and appropriate processes, preparing the workforce for future requirements, and establishing long-term strategies.
- The article by *Schartmüller*, *Steinbrunner*, *Bruck* and *Hennig* sheds light on the complex social phenomenon of multi-locality. Especially in rural areas, the interplay of presence and absence of residents is associated with some of the most pressing challenges in terms of sustainable development, e.g. mobility, land consumption, housing, social infrastructure, community life, tourism. For four case study regions in Austria, the authors present a mixed-method approach combining guided interviews, focus group discussions with multi-locals, and workshops with international experts. In addition,

planning measures for local municipalities and regions are highlighted depending on their regional characteristics.

- The methodical approach and main findings of the research project PaEGIE (Participative Energy Transformation: Innovative Digital Tools for the Social Dimension of the Energy Transition) are presented by *Stahl, Ritter* and *Linke* in their article. As the transportation sector is a major contributor to greenhouse gas emissions in Germany, a transition to sustainable mobility is needed considering the different mobility needs among individuals and neighbourhoods in order to achieve the climate goals. The authors explore different attitudes and demands of residents in different neighbourhoods and confirm the hypothesis that a neighbourhood-specific approach to mobility planning is necessary.
- *Wolff, Schaffert, Cruz* and *Cherifi* investigated the interactions between spatial planning decisions and demographics on the one hand and infrastructure and well-being on the other, with the aim of understanding the complex interdependencies and of designing and implementing a model to verify interactions and influencing factors. Focus was given on single-family housing areas in rural regions of Germany. For example, the construction of a new retirement home could lead to reduced travel times or costs for relatives, but also attract older people from the surrounding areas, which could lead to underutilization of single-family houses.

The final part of the book is dedicated to the qualitative and quantitative evaluation of land and land management processes. In addition to monetary evaluation, the concluding articles also address some social issues.

- *Hendricks* and *Lewis* introduce a theoretical research study on public value capture in connection with large infrastructure projects. The tools for public value capture are examined in the form of a discursive literature analysis. International best practices have indicated that governments typically employ recurring tax- and fee-based mechanisms. However, non-recurring forms became more and more important over the past 20 years and contract-based value capture techniques – such as development agreements, community benefits agreements, and joint development agreements – are among the most evolved value capture techniques available today. They provide more flexible and less litigious solutions to generating new revenues. Also, the results of this study support the idea that the entities with an advantage from the new infrastructure should be targeted for funding.
- In 2021, students at the Mainz University of Applied Sciences mapped five places in their everyday lives in the city of Mainz, Germany. They selected the places according to their wellbeing (from ‘feel good’ to ‘have suggestions for improvement’). The students were then asked about their ratings and choice of places. *Kaminski* and *Schaffert* conducted a low-cost qualitative GIS approach using a semi-automated speech recognition toolkit and content analysis. Results show that sketch maps are constructed based on historical personal experiences and group-specific shared circumstances.

- In the article by *Süring* and *Weitkamp*, the mixed-method approach is adopted to investigate house buyer's perspective to demonstrate some criteria, which could explain the difference between the housing market value and transaction price, and recognise what is price-influencing for buyers of real estate. The research has been conducted in Germany.
- Disparities in property prices between the areas that have undergone urbanization through land readjustment and the areas that have experienced urbanization without such intervention are investigated by *De Souza* and *Linke*. A multivariate regression analysis and a buffer analysis are applied resulting that higher property values have concentrated in areas that have undergone land readjustment.

In this book, sustainable and equitable land management is described from the perspective of experts covering various disciplines, including spatial planning, surveying, sociology, law, soil science, and informatics.

Overall, the presented articles contribute to the knowledge and awareness of sustainable land management challenges from different professional perspectives. The book intends to encourage the reader to consider the interdisciplinary aspects and views in land management processes.

*Reinfried Mansberger*

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# The Assessment of Land Resource Management for Sustainable Spatial Development

An assessment model, comparative study, and evaluation of land resource management in selected countries

## Abstract

Considering the rapid increase in population and the resources needed by these residents to ensure an adequate standard of living, issues about the rational use of land resources become more and more relevant. Sustainability aspects in land management refer to the future-oriented changes when creating necessary preconditions for balanced interests in using land-related resources. Land management practice primarily reflects both interests of spatial development and preservation of natural resources. The study focuses on the analysis of the legal framework and the proposal for evaluation of the management of land-related resources in the context of sectoral policies and spatial development planning. The developed model has been tested to provide an evaluation of the results of land resource management in five European countries.

## 1. Introduction

Rapid global population growth and the necessity for resources to sustain it (United Nations 2019), combined with one of humanity's greatest challenges – climate change – is putting pressure on land use policymakers to develop environmentally sound, socially inclusive and economically efficient land use plans. To promote effective and science-based land resource management (LRM), policymakers need tools that can be used to assess how land-related resources are managed. In this study, the LRM is attributed to the characteristics of spatially allocated values of “land-related resources” (Auzins and Chigbu 2021:8–9), which “can be seen in landscape as a stock; factual land-use types or geospatial units in the frame of a particular project, e.g., agricultural land, forest, waterbody, roads, built-up land, etc.” Therefore, these resources may be recognized spatially as being both provided by ecosystems and human-made formations and managed mainly by those who make decisions regarding land-use planning and the implementation of the plans.

A sustainable future may be seen by focusing more on diminishing or changing development needs in the way to minimise the impact on the environment and natural land resources (Auziņš 2019). The objectives of this study are directly aimed at more efficient use of land resources, taking into account policies and challenges that have a territorial impact. These

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\* Riga Technical University, Faculty of Engineering Economics and Management, Latvia.

are mainly policies of land, environment, spatial development, agriculture, and forestry, the assessment of which will consider the territorial interests of sectors like agriculture, forestry, important production and construction infrastructure.

The “legal framework” (LF) for the use of land resources has been analysed in the context of spatial development planning in Latvia. The LF as such has not yet been properly defined. However, it appears as a list of laws and regulations in the context of identified sectors, e.g., construction, financial management, and social entrepreneurship. In the study of the National Research Program (LandLat4Pol)<sup>1</sup>, LF was assumed as it: (1) determines or regulates processes, activities and relationships; (2) is substantiated and can be relied upon; (3) governs rights, limitations and liability; (4) constitutes a set of legally binding documents and guidelines (Latvian Council of Science 2020). The hierarchy of “sources of law” consists of primary regulatory documents (legal and regulatory enactments) concerning the processes and procedures regulated by regulatory enactments and legally binding regulations (Latvijas Vēstnesis 2022). The study also evaluated guidelines, directives, regulations, policies and court decisions. LF for the use of land resources has been assessed in the context of sectoral policy planning and spatial planning. Areas that have a territorial impact on land use efficiency, incl. thematic areas<sup>2</sup> and sectors’ policies<sup>3</sup> are legally regulated. In general, it was concluded in the study, that the use of land resources fits into an interdisciplinary area of law, incl. a set of constitutional, administrative, civil and criminal law sources.

Considering the key outcome of the analysis of LF, *the purpose of this study* is to propose an approach for the evaluation of the LRM in the context of pre-existing and sometimes competing sectoral policies and spatial development planning. Accordingly, the study evaluates LRM by identifying sustainability criteria and providing a model of management assessment based on the basic principles of sustainability and proposes a structure for quantitatively evaluating said LRM approach. To develop this model, the workflow includes the basic conditions of sustainability, land use objectives and planning approaches, the assessment model of LRM, and the characteristics of LRM in selected countries and testing of the model. Finally, the indicator system, management evaluation index, and main conclusions are provided in the study.

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<sup>1</sup> National Research Program (LandLat4Pol) “Sustainable land resource and landscape management: challenges, development scenarios and proposals” was carried out for preparing proposals for principles and actions that promote the efficient use of land resources that meet future challenges (2020-2022).

<sup>2</sup> Thematic areas, e.g. transport, environment, housing, industry, commerce, agriculture. Source: OECD (2016), Land-Use Governance Survey 2016, <https://www.oecd.org/gov/governance-of-land-use.htm>.

<sup>3</sup> Specific focus on sectors’ policies/interests in the management of land-related resources: (1) nature protection, (2) landscape management, (3) agriculture and rural development, (4) forestry, and (5) water management.

## 2. The analysis of the legal framework

The analysis of LF (which is primarily based on Latvian legal sources) focuses on what currently hinders efficient land use from the legal standpoint and what can be changed to promote efficiency. The evaluation of the LF for the use of land resources was performed by applying a systematic content analysis of the sources of law following the previously established hierarchy and levels of land management (Latvian Council of Science 2020). Looking at land management in the context of socially important policies and evaluating the means and methods for developing and improving the land management system, it is necessary to identify significant limitations and actualities in the relations between (often competing) land management subjects (public and private), in the development of urban and rural areas and in ensuring efficiency. Spatial development planning as a land use and development monitoring system in Europe (Larsson 2011) is mainly based on a comprehensive integrated and participatory approach, decentralization in decision-making, but respecting the priorities and interests determined at the national and regional level, which are defined in sustainable development strategies and guidelines (Auziņš 2018, 2020). It is important to note, while the emphasis is on Latvian LF of land use management, the principles used for analysis can be more broadly applied to evaluate the LF of other countries.

The analysis of LF reflected the *LRM model* in the country. *Land Management Law* (Latvijas Vēstnesis 2014) defines “land management” as a set of land policy implementation measures aimed at promoting sustainable land use and protection; “land administration” – acquisition of data characterizing land and its use from state information systems, their analytical processing and periodic survey of land in the area to determine the condition of the land and characterize its changes. The Cabinet of Ministers (central government) is responsible for approving the State land policy. The law also determines principles and conditions for the use and protection of land; land for ensuring public infrastructure and access; land consolidation; management of State and local government land; land and soil protection and quality assessment; land monitoring and information related to land.

Three *land management levels* (national, municipal, and land users’) and three *spatial planning levels* (national, regional (5 planning regions), and municipal (43 local governments) have been identified in Latvia.

*The land policy* should be implemented in a certain institutional environment by operating land management and land administration. The organizational units involved in land monitoring and LRM processes cooperate in the performance of the defined tasks and coordination of activities. *Land policy* is a conceptual strategic cross-sectoral planning document, in which strategic goals and action policies or operating principles are defined in a concentrated form. Such a document has been developed (not adopted) to preserve the land as the basis for the existence of a nation-state and national wealth, as well as to reconcile the interests of various sectors in land use (Latvijas Vēstnesis 2016; Cabinet of Ministers of the Republic of Latvia 2018).



*The regulatory framework* of land law regulates real estate and land use rights and ensures land use planning and real estate development, land use for land plot infrastructure improvement, environmental and nature protection measures, and real estate and natural resource tax administration, as well as restrictions on rights and liability violations. The *specific sectors* develop and implement their policies, development programs, and plans, e.g., agriculture, forestry, water management, and nature protection. *The geospatial information framework* provides real estate market and cadastral information, topographic and sectoral thematic maps of various scales, as well as geospatial information databases. The goals and tasks of those involved in *land administration* are focused on the legal protection of real estate rights and transactions, ensuring balanced and sufficiently coordinated land use processes, and the organization of real estate valuation and market promotion, as well as contributing to the development of environmental infrastructure and fair tax policy. Thus, the objectives and responsibilities of LRM are aimed at the practical implementation of land use and protection policy, but their activities ensure relevant processes. Both strategic and development-promoting and process-ensuring decisions for attracting investments and developing land infrastructure are created and adopted, providing the conditions for increasing the efficiency of land resource use (Auzins et al. 2022).

The *key outcome* from the analysis of LF in Latvia shows that the Land Management Law was adopted in 2014, which is much later than the respective sectors' authorities and regulations had been established and gradually developed since the 1990ies. The formal definition of "land management" includes "a set of land policy implementation measures...", however, there are still a lot of discussions around the necessity of a uniform land policy in the country. Sectoral interests are quite self-directed, which caused a lack of a common overview of LRM. Monitoring should be based on updated information and periodic land use assessment. LF does not explain how sustainable planning is and how it affects the efficiency of land resource use, therefore a planning-implementation linkage and evaluation of implementation effects should be emphasized. The benefits of implementing land consolidation are seen more in reducing public administrative burdens and budget expenditures, as well as in simplifying processes, rather than in positive (socio-economic) effects on the agricultural sector and rural development in the long run. The lack of efficiency assessment, deliberation and cooperation during the spatial planning process has been observed as well. Sources of environmental law are a set of time-varying norms that significantly affect the operating principles of other sectors more than environmental protection, especially in the context of spatial planning in Latvia.

Finally, looking at the LF in the economic context, the following question arises: how the rights, restrictions, and responsibilities determined in the LF affect economic outcomes, and what should be paid attention to when implementing LRM, considering both legal regulation and economic outcomes. Ownership of land, or any other form of real estate, is part of the pillars of modern society's freedom. In the economy, it is essential to define and uphold real property rights by increasing the benefits it provides. Many examples of the use of land-related resources in the organization of economic activities show that the regulation

of the use of land resources must be comprehensive and determined following national long-term goals. By analyzing the LF, it is possible to determine whether the legislation of the respective country restricts or promotes the sustainable development of territories and this is ensured through management. Laws are enacted at the national level. European Union countries also agree on international regulations and directives that are ratified at the national level. Sometimes regulations with binding legal force are also adopted at a regional level. In Latvia, municipalities have the right to issue binding regulations to the extent that these regulations are not conflicting with national legislation (or any hierarchically higher legal document). An important influencing aspect of LRM is the assessment of mutual agreement and consistency within the legal sources. The outlined assumptions, therefore, indicate the potential benefit of an assessment model for evaluating and comparing LRM systems.

### 3. The assessment model of land resource management

The study identified and characterized preliminary indicators that can be used to evaluate land management systems. When conducting an analytical comparison between the land management systems of several countries, it is necessary to choose indicators that objectively reflect the differences between the objects of analysis. Each country's national, regional and local land use goals may differ, as a result of which the assessment of land resource use performance should be evaluated in the context of the fulfilment of the respective country's goals. However, taking into account that this type of comparison would largely not be practical and would not allow for a substantial comparison between countries with quantitatively different objectives when selecting quantitative criteria for the comparability of land management systems, indicators that would provide a general, yet comparable description of the land management system and its performance are taken into account.

The selected indicators correspond to the characteristics of sustainable LRM – productivity, security, protection, viability and acceptability. This ensures that the indicators included in the model are consistent with the principles of sustainability (SDGs, especially SDG 15). Not all indicators have to be directly related to the efficiency of the use of land resources, they can also be derived. Indicators for this analysis fall mainly into one of three categories: social indicators, economic indicators and environmental indicators (see Figure 1). However, they can fit into more than one of the categories, for example, the unemployment rate is a socio-economic indicator that describes both the social and the economic situation. It would be possible to include one indicator in several categories, applying a reduced weight in each of the categories. Such a structure of the model is worth considering in cases where the number of indicators to be included in one of the categories has significantly decreased compared to the original model. However, for this study, the indicators included in the model are categorized based on their primary association with one of the categories.

### 3.1 LRM evaluation index

When looking at the LRM goals, three essential values were highlighted: *human*, environment and economy. The objectives of land management are directly related to these three values. When developing the model, it should be possible to adjust it and adapt it depending on the need of any relevant situation. The initial model may include indicators that would be desirable to estimate, but for which the information available to estimate may not be available. Therefore, in the process of developing the model, it is necessary to include mechanisms that would allow the development and adaptation of a simplified version of the model. Considering that different weights may be assigned to different LRM evaluation indicators included in the model, it is necessary to foresee the possible redistribution of these weights to other indicators not excluded from the model.

The model is developed to obtain one composite indicator (index) that comparatively characterizes the current performance of one LRM framework compared to other LRM frameworks. This comes with its limitations. It is assumed that the indicator would not be all-encompassing as there are severe limitations to evaluating a whole system for LRM using a single quantitative indicator. Nonetheless, an aggregation of multiple sub-ordinate and descriptive indicators in a single value can prove useful for ease of comparison and can serve as a first step to compare management efforts. Lastly, an important critique raised about this type of indicator is that, without a substantive review of each company's historical economic landscape, the indicator's results may be inflated or deflated depending on the region's historical economic, social or environmental performance. For each of the categories of indicators included in the model, its index value is calculated, which is created based on the indicators included in the category. To obtain the LRM assessment value, the scores of these three categories, according to the importance applied to them, are combined to calculate a weighted average value. The LRM assessment value is characterized by Formula (1):

$$MEI = I_{soc} \times n_{soc} + I_{eco} \times n_{eco} + I_{env} \times n_{env} \quad (1)$$

where MEI – LRM evaluation index;

$I_{soc}$  – index of social indicators (social index);

$I_{eco}$  – index of economic indicators (economic index);

$I_{env}$  – index of environmental indicators (environmental index);

$n_{soc, eco, env}$  – the importance of the  $I_{soc}$ ,  $I_{eco}$  and  $I_{env}$  in the MEI (these values may be changed based on assumptions about the relative importance of environmental, economic and social factors in the sustainable development of territories).

The values of the index components are represented on a scale from zero (0) to one hundred (100), however, the model provides an option to choose a different scale depending on the needs of analysis. The index consists of three components, which are also evaluated in values from 0 to 100. The index is relative and can be calculated by looking at a set of countries or management systems. A comparable value is required for the model to function. The model

was developed this way because it is impossible to objectively determine the maximum value for most indicators, however, this approach also limits the applicability of the model for evaluating one management system, i.e. using this approach to evaluate the efficiency of LRM, a reference point is always needed. Depending on the metric included in the model and whether high or low values for that metric are considered desirable (think desirability of high pollution or desirability high GDP), appropriate formulas are used to calculate the relative value of that metric, which is expressed on a scale from 0 to 100. In cases where a higher score is desirable, i.e. a higher score describes a better situation than a lower score, the highest of all countries' respective scores is used to estimate the index of the other countries' respective scores. Such indicators are, for example, the number of inhabitants per built-up area, public investment and productivity. The indicators hypothesized in the evaluation are called growing indicators, and the index values of these indicators are calculated using Formula (2):

$$I_n = \frac{X_n}{\max(X_n)} \times 100 \quad (2)$$

where  $I_n$  – index of the respective country;

$X_n$  – indicator of the respective country;

$\max(X_n)$  – the highest indicator value among all countries.

Using this formula, it can be seen that the country with the highest observed indicator is always assigned a value of 100, since in that case the analyzed country's indicator is included in both the numerator and the denominator. 100 is the highest possible value on the scale used to rate the index of the relevant indicator for all other countries. In cases where a lower score is desirable, i.e. a lower score describes a better situation than a higher score, the lowest of all countries' respective scores is used to estimate the index of the other countries' respective scores. Such indicators are, for example, the relative frequency of recommendations for amendments, the relative frequency of violations of regulatory acts and the proportion of environmentally harmful areas. Such indicators will be defined in the text as descending indicators, and the index values of these indicators are calculated using Formula (3):

$$I_n = \frac{\min(X_n)}{X_n} \times 100 \quad (3)$$

where  $I_n$  – index of the respective country;

$X_n$  – indicator of the respective country;

$\min(X_n)$  – the lowest indicator value among all countries.

As can be seen, in contrast to increasing indicators, when calculating the index values of decreasing indicators, the comparative indicator is chosen to be the smallest among the indicators of all countries. The index value assigned to this indicator is always 100. A major drawback that can be identified in the calculation of both decreasing and increasing indicators is the fact that both index calculations do not consider whether the differences in

the indicators of the two countries represent real differences. For example, if the countries included in the model were measured for road availability and it was identified that country «A» has a road index of 80 and country «B» has a road index of 40, this would effectively mean that country «A» has twice as many roads per unit area, but it does not describe whether twice more roads per area is twice as good. It does not ascribe a normative value. Unfortunately, taking into account the individual characteristics of each indicator, developing index values for different indicators that can be combined into one index has significant practical complications. Solving them would require a separate individual analysis of the indicators, characterizing the dynamics of the indicator and the relative economic benefits of marginal values compared to the sum of values. The calculated index values of descending and ascending indicators are used to calculate the indices of social, economic and environmental indicators ( $I_{soc}$ ,  $I_{eco}$ ,  $I_{env}$ ) determining their share in the MEI.

$I_{soc}$ ,  $I_{eco}$  and  $I_{env}$  are calculated based on the values of the indicators included in each of the categories, which are evaluated relatively and are expressed as index values. The importance of the  $I_{soc}$ ,  $I_{eco}$  and  $I_{env}$  can be determined based on the indicators to be included in each category and their mutual importance, as well as the goals to be achieved by the user of the MEI, as well as based on the expert assessment of the importance of each category and indicator.

### 3.2 Indicator system

Based on the above, the assessment model includes indicators in a three-level hierarchy. At the highest level, LRM is characterized using a management evaluation index (MEI). The middle level describes each of the categories included in the MEI, while the lower level describes the specific indicators included in the model. MEI consists of three sub-indices, which are calculated based on the selected indicators. The number of indicators included in each of the sub-indices differs and the proportions applied to these indicators in the index also differ. To determine the share of an indicator in the overall MEI assessment, the share of the indicator in the index of the relevant category is multiplied by the share of the category in which the indicator is included in the overall MEI. Although it is possible to calculate the MEI without dividing the individual indicators into economic, environmental, and social indices, these sub-indices are created to give a better idea of the situation of a certain country in each of the categories. Figure 1 shows a structured indicator system for the application of the assessment model and making calculations.

As can be seen in Figure 1, the hypothesized preliminary MEI consists of three sub-indices, which are composed of a total of 15 indicators. The social index includes six indicators, the environmental index includes five indicators and the economic index includes four indicators. Taking into account that the model envisages changes in the indicators and the proportions assigned to them, including the development of a simplified version of the model, based on the indicators of the existing model, a redistribution of the proportions of the indicators is proposed.

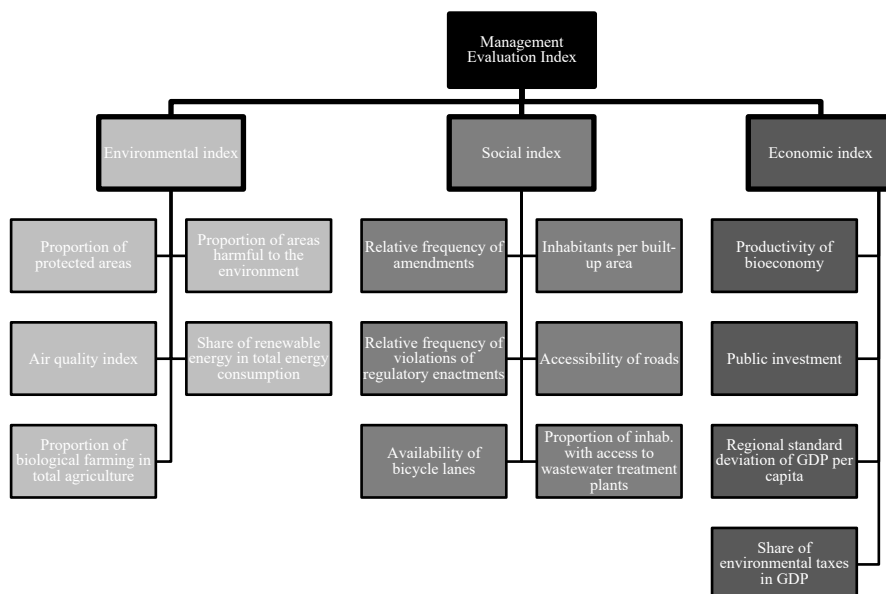


Figure 1: Indicator system.

Considering that all the indicators included in the model are transformed into an index that is on a scale from 0 to 100, these indicators are mutually comparable and replaceable to the extent that the substitute indicators describe the use of land resources and related activities. In the case that one of the indicators is replaced by another, it is necessary to make sure that the importance of both indicators is the same. If both indicators are found to be equally significant, then the proportion of the indicator remains the same, and the proportions of all other indicators of the relevant sub-index remain unchanged. In cases where an indicator contained in the model is excluded from the model, the proportions of the remaining indicators in the model must be increased by the multiplication of the importance of each relevant indicator and the proportion of the excluded indicator. The redistribution of the share of the excluded indicator is carried out using Formula (4):

$$n_{new} = n_{prev.} \times \left(1 + \frac{n_{excl.}}{1 - n_{excl.}}\right) \tag{4}$$

where  $n_{new}$  – proportion of an indicator remaining after excluding another indicator;

$n_{prev.}$  – proportion of the indicator remaining before the exclusion of another indicator;

$n_{excl.}$  – proportion of excluded indicator.

In cases where several indicators are excluded from the model at the same time, the share of the excluded indicator is replaced by the sum of the share of all excluded indicators. Accounting for all the above, the application of the model can be described in the following steps:

1. Selection of countries to be evaluated within the framework of the model;
2. Gathering of data for the indicators included in the model;
3. Transformation of model indicators into an index using the formulas of decreasing (2) or increasing indicators (3);
4. Calculation of sub-indices using indices of indicators obtained in step 3;
5. Calculating the MEI applying Formula (1).

After the calculation of the MEI, it is possible to compare the LRMs in different countries and evaluate possible improvements in the land management system.

#### **4. The assessment of land resource management: a model testing**

In order to make a cross-country comparison, it is necessary to indicate the motivation for the selection of the relevant countries and to provide an overview of these countries to use the obtained data and test the previously proposed evaluation model. Three Baltic countries, namely Latvia, Lithuania and Estonia, as well as Austria and Sweden, were selected for the study. The characteristics of national land management systems are essential to provide a general insight into the functional differences between countries and the peculiarities of each country's land management system. It is also necessary to identify the peculiarities of the territory and land use of each country. Since the land use planning and LRM of each country can be significantly influenced by the physical characteristics of the land and territories, a previously conducted comprehensive comparative study (Auzins et al. 2022) justified the choice of the relevant countries and characterized not only the land management system of each country (Latvia, Lithuania, Estonia, Austria and Sweden) but also the land coverage and land use structure of the mentioned countries.

The first step in model testing is to obtain quantitative data on selected indicators that are included in the evaluation index. Given that the authors were unable to find data for all the indicators included in the model, some of the mentioned indicators were not included in the model testing. When calculating the social index, it was found that data on three of the indicators included in the social index are not available. These indicators are "relative frequency of amendments", "relative frequency of violations of regulatory enactments" and "availability of bicycle lanes". Considering that the values of these indicators were not available, the remaining social index indicators were used to calculate the social index. Due to the lack of particular comparable data, the proportion assigned to the excluded indicators was redistributed to the indicators left in the index using the formula (4).

##### **4.1 Calculation of environmental index**

The highest environmental index can be observed in Sweden, in which the environmental index is 88.67, while the lowest environmental index was given to Lithuania, in which the environmental index is 58.42. Taking into account that the relative indices of the indicators included in the environmental index in each indicator category were calculated concerning



the best indicator in the category, the indicators of Lithuania were most often significantly lower than the indicators of other countries. All countries, except Lithuania, were given the highest value in one of the five indicators.

Based on the available information, Latvia has the lowest proportion of environmentally harmful territories compared to the other four countries. At the same time, Latvia also has the lowest proportion of protected areas among all countries. Estonia has the highest proportion of protected areas, and Estonia also has the lowest air pollution. It can be seen that of the five countries, Sweden has the highest share of renewable energy in total energy consumption, while Lithuania has the lowest. Austria has the highest share of organic farming in total agriculture, and Lithuania has the lowest. The share of organic agriculture in agriculture is 25.33% in Austria, 14.79% in Latvia and 8.14% in Lithuania. In Sweden, 56.39% of energy consumption is provided by renewable energy. For Latvia, out of the five comparable countries, this indicator is the second highest and it is 40.98% of the consumed energy. In Lithuania this indicator is 25.46%, in Estonia 31.89% and in Austria this indicator is 33.63% of the total energy consumption. Taking into account that the air pollution indicator and the renewable energy indicator were assigned the highest share values (25%), Estonia and Sweden, which respectively had the highest value in each of the indicators, also obtained relatively high values in the environmental index.

In the EU, it is determined that by 2030, the share of an organic farming area in the total agricultural area must be at least 25% (EC 2020). Therefore, to achieve this goal, in Latvia, Sweden, Estonia and especially in Lithuania, it is necessary to pay increased attention to organic agriculture in the LRM. However, all these countries have seen an increase in the proportion of organic farming in recent years. In the period from 2011 to 2019, the share of organic agriculture in Estonia has increased by 8.23 percentage points, in Latvia by 4.69 percentage points, in Lithuania by 2.74 percentage points, in Austria by 5.73 percentage points and in Sweden by 4.73 percentage points (Eurostat 2021). The fastest relative growth can be observed in Estonia with an annual growth of approximately 7.30%. The lowest is observed in Austria, where an annual increase of approximately 3.65% is observed. The relatively slow growth rate in Austria is probably due to the fact that already in 2011, a significant part of the agricultural areas was used for organic farming in Austria.

#### 4.2 Calculation of social index

Austria has the highest social index (100) of the five selected countries. This means that in all the indices of the social indicator, Austria's scores were the best. Recalling that, when calculating the index of each indicator, they are applied to the best indicators of all countries, which means that by inserting additional countries into the model, the social index of Austria could decrease. Among the remaining four countries, Latvia has the highest index of 73.77. Sweden has a slightly lower index 72.37, while the social index for Estonia and Lithuania was 65.57 and 65.15, respectively.

It can be seen that for all countries the social index is significantly reduced by the road accessibility indicator, which makes up a little more than a quarter of the total index. The



lowest number of inhabitants per built-up area is observed in Lithuania, and the lowest proportion of inhabitants with access to wastewater treatment facilities is also observed in Lithuania. Lithuania has the second highest road accessibility index. Even though Latvia's indicator "number of inhabitants per built-up area" is slightly lower than Sweden's indicator, Latvia's road accessibility indicator is higher than Sweden's. Therefore, the overall social index for Latvia is higher. It can be observed that in Austria the length of roads per square kilometre is 105.10 kilometres, while the country with the second highest indicator, Lithuania, has a road length per square kilometre of 43.02 kilometres, which is less than half. It has already been mentioned that this indicator characterizes the road infrastructure. Looking at the population index, i.e. the number of inhabitants per unit of built-up area, the highest figure can be observed in Austria, which is 1,769 inhabitants per one square kilometre of built-up area. The lowest of the indicators is in Lithuania, which has 1,256 inhabitants per built-up square kilometre.

#### 4.3 Calculation of economic index

Sweden's economic index, like the environmental index, is the highest of all five countries included in the model, at 79.93. The lowest economic index was determined for Lithuania and it is 53.12. The second highest index is Austria with 66.81, the third highest is Estonia with 63.42 and the fourth highest is Latvia with a value of 62.97. In all three categories, Lithuania was assigned the lowest index.

All four categories included in the economic index were given an equal share of 25%. The highest value of the bioeconomy productivity indicator was assigned to Sweden, where the bioeconomy productivity is 63,011 euros per employed person, and the lowest to Latvia, where the bioeconomy productivity per employed person is 16,804. This shows that not enough added value is created in the bioeconomy sector in Latvia. In the indicator "public investment", Latvia has the highest indicator of all countries, and it is 2% of the GDP. In Austria, this indicator is the lowest, and it amounts to 1%, half of Latvia's. Latvia also has the second highest ratio of environmental taxes in the GDP of all countries, where environmental taxes amount to 2.96% of the GDP. Estonia is the only country with a higher indicator and it is 3.16% of the GDP. The large share of environmental taxes in Latvia is mainly related to excise tax and tax on natural resources. The highest regional inequality has been assessed in Latvia, where the standard deviation of the GDP per capita is 6,808 and the coefficient of variation is 55.16%. Significantly lower inequality is observed in Austria, where the standard deviation coefficient of variation is 17.40%, and in Sweden, where the coefficient of variation is 19.43%. Estonia's indicator is very similar to Latvia's, with a coefficient of variation of 50.79%. In Lithuania, the standard deviation is the smallest standard deviation of 4,511 euros, while the coefficient of variation is 34.78%.

#### 4.4 Management Evaluation Index

After sub-indices have been determined for all countries, it is possible to calculate the MEI. Although it is possible to adjust the proportion of each sub-index in the calculation, this time the environmental, social and economic index will be given equal weight, i.e., make up

one third of the MEI. Considering that the same proportion was applied to all components, MEI is formed by the average value of all three sub-indices. The values of MEI and its included components for Estonia, Latvia, Lithuania, Austria and Sweden are shown in Figure 2.

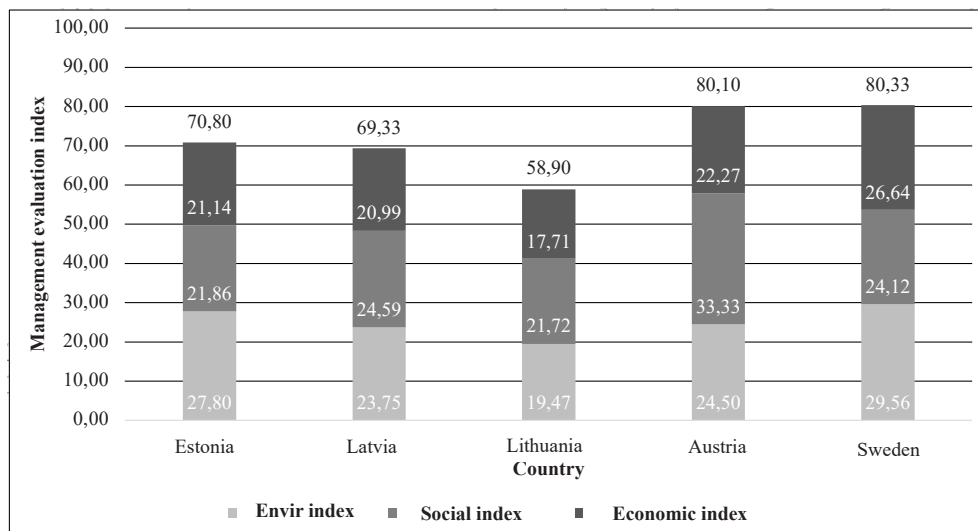


Figure 2: MEI for the compared countries – Estonia, Latvia, Lithuania, Austria and Sweden.

As can be seen, Sweden has the highest MEI value, while Lithuania has the lowest value. Based on the results of the management assessment model used, the MEI for Sweden is 80.33, for Austria 80.10, for Estonia 70.80, for Latvia 69.33 and for Lithuania 58.90. It can be seen that in Latvia, Lithuania and Austria the largest component was the social index, while in Sweden and Estonia the component that significantly increases the MEI of the respective countries is the environmental index.

When testing the model, three of the indicators included in the social index were not available, which would probably significantly change the results of the model, and even more the relative position of the countries, since the difference between the MEI of Estonia and Latvia is 1.47 points, while between Sweden and Austria this difference is even more less – 0.23 points. To interpret the obtained results and to be sure of the applicability of the model, it is necessary to conduct an in-depth analysis of how the results of the model are compared with studies that characterize the land management systems of each country.

## 5. Conclusions

The study developed the LRM assessment model. The applicability of this model and its ability to successfully identify management effectiveness is subject to further research. It is possible to assess the effectiveness of LRM by looking at the performance indicators characterizing national-level land management goals and comparing the changes in these

indicators under the influence of different management arrangements. Land management for sustainable territorial development ensures the promotion of biological diversity, soil quality, inexhaustibility of renewable resources, economic efficiency, and provides development opportunities for the future.

The applicability and results gained from the LRM assessment model are limited by the lack of quality data and functional differences in national land resources. It is possible that the values of several indicators, for example, the values of missing social indicators, can be obtained using qualitative research methods, including sociological surveys or expert assessments. The indicators included in the set of indicators characterizing the LRM are evaluated over time to see the impact of the mentioned indicators and their connection to the management process. Based on the results of the model, the highest environmental and economic index was determined for Sweden, while the highest social index was determined for Austria. Based on the model results, Lithuania's MEI was the lowest among the five countries. The developed model can be used to assess the current situation of LRM, without considering the dynamics of changes in results. The choice of land and land resource use classification depends on the purposes of its use and available statistical data. Regulations and policy planning documents for the use of land resources should be developed considering the goals of the national level. The overall goal of LRM is to ensure the balance between sustainable development of territories and land protection. This goal in Latvia is defined in national-level planning documents and by the Land Management Law. The land management systems of all the considered countries at the national level consist of three levels of land management and three spatial planning levels. To ensure effective planning of the use of land resources, it is necessary to promote integration between levels and cooperation between sectors. It is necessary to ensure consistency and mutual synergy in land resources legislation as well.

When selecting indicators of land resource use, it is necessary to choose indicators that objectively and measurably reflect the current situation, and which can be used to justify decisions. An optimal land use planning approach is chosen based on the functional and social characteristics of the respective region. LRM assessment model that includes only quantitative indicators cannot be comprehensive. In this study, the model has been developed with the possibility of adjusting it based on the available information and data, as well as changing the proportion of the selected indicators in determining the final value. To improve the model and expand the possibilities of using the model, it is necessary to significantly increase the range of indicators to be included in the model. In order to make sure that the results of the model correspond to the actual situation, it would be necessary to compare the results of the model with qualitative studies that describe the management systems of the respective countries. The LRM assessment model should be refined to include target values of indicators to ensure the applicability of the model in assessing individual systems without looking at that system against other management practices. The model should be supplemented with qualitative indicators. The public institutions of the respective sectors should provide comparable and accessible information, including about the built

total length of bicycle lanes and the number of regulatory violations, segmenting the number of violations by sector.

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# Spatial Planning in Fragmented National Planning Systems – The Case of Norway

## Abstract

Building and planning acts hardly provide a complete understanding of the planning system when the legislation of national systems for public spatial planning are approached. Over time, rules and regulations will be changing both functionally and territorially. Many additional rules and principles come into play, from administrative law and from the legal culture more generally. Moreover, additional rules and principles may reflect territorial or material fragmentation. Indeed, how the system is constructed, and how it works, depends also on the territorial and the material scope of the various bits of legislation currently in force, and how this has changed over time. In this work, we show that such disconnections also appear in the Norwegian legislation for spatial planning as we inquire into how this legal system of different rules and regulations is constructed and coordinated. The findings reveal that one can hardly perceive the national legal system for public spatial planning as an unabridged entity. It consists rather of variants and even sub-systems, both within and along the outer zone of the territory where the main legislation for land use planning and building is nominally in force. Consequences for planning and the building control are tentatively discussed.

## 1. Planning systems for what and where?

### 1.1 The planning and building approach

Attempts to guide courses of events in a way that will lead to deliberated outcomes are normally associated with planning. Spatial planning under public rule takes place in accordance with legal rules and regulations. This applies to the planning initiative, the preparation of the actual plans, the subsequent formulation of planning provisions, and the obligatory public process that might lead to the authorities' final approval that will turn plans into statutory documents for the governing of future public and private decisions. The main purpose of planning so conceived is to govern the use and utilisation of land and to control building activities that will take place within the planning area. Hence, planning regulations can in general be applied to determine where and conditionally whether buildings or other types of constructions should be built, designed and protected. This decision-making about future possibilities becomes decision-making about actual development schemes when we combine regulations in adopted plans with subsequent

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building control. Through this control, regulations expressed in the plans, alternatively in other public documents, must be evaluated to reach a decision on whether to approve the building application, approve it on certain conditions, or reject it.

When considering the planning system of a specific country, one might hypothetically expect to find a uniform system for planning within the territory governed by national legislation. In the Norwegian example, the existing Planning and Building Act (PBA), LOV-2008-06-27-71 should be the relevant legislation. If this was the case, all forms of land use planning within the territorial scope of this act would take place in accordance with its rules and regulations. Assuming all kinds of activities and operations relating to land to be included, it would also be supposed that the planning process itself was regulated in a uniform way. Should this be the case, the legislation and the institutions that operate under it, along with the practices they give rise to, could rightly be referred to as the “national planning system”.

When planning theory gained academic relevance in research and education in the fields of planning behaviour and planning processes, the legislation for urban and regional planning was almost without exception understood as the legal underpinning of the “planning system”. Planning operations had to take place according to these rules and regulations in the authorities’ attempts to govern the development of the surroundings (Faludi 1973; Davies et al. 1989). But as the former later commented upon in this early phase; a planning system should also open the possibility for making considerations that go beyond the ordinary planning approaches and evaluations. This could mean special consideration for issues related to the formalisation of the planning process, ownership, or property rights. A part of this was also to spell out the considerations that the involved authorities had to consider to show due concern for those affected by the plans, whether it should be actors involved in the planning process, other directly affected persons, or third parties (Faludi 1987). This might in turn require the use of legislation beyond that which sets out the national system for actual spatial planning. In such situations, planning will need additional legal foundations or rules that help coordinate the ordinary planning rules with the specific legislation needed to safeguard specific interests. In this way, the legal foundations for planning may become more pluralistic. This pragmatic and perhaps realistic understanding of the planning systems’ functional limitations indicate that a planning and building act may not be the only legal basis for planning and building control within its territory.

## 1.2 Alternative legal frameworks and exceptions

For the reasons outlined above, we ask whether and in which situations there should be plans for implementation prepared pursuant to other legislation. Furthermore, we question whether this legislation can or must be used for deciding about land use and for obtaining building approval. We also address whether it is or should be possible to get approvals for certain kinds of constructions independently from or in conflict with rules and regulations in the ordinary planning and building legislation. This legislation might for certain planning and building purposes facilitate the use of regulatory power that come under the purview of

other government bodies. In consequence it might be possible for such government bodies to zone land for some kinds of uses, or perhaps just facilitate existing uses in land and built-up structures by shielding them from the ordinary planning process.

Under such circumstances, it might be possible to implement building projects without adhering to the rules and principles of the “planning system” narrowly understood. To the extent one encounters such alternatives to the general planning legislation, one may also choose to regard the “planning system” itself as a composite legislative framework giving rise to variants based on exceptions from ordinary procedures or consisting of different legal “sub-systems” for planning and building.

The assumption of a territorially and functionally coherent planning system can also be modified by the fact that spatial planning will have to take place on different political and administrative levels and at different scales. Planning across different levels will inevitably result in challenges. A key question is how general regulations from superior bodies at the national, regional, or local levels, should influence planning that takes place on subordinate levels at smaller scales and manifests in building control with regards to specific schemes.

### 1.3 Planning levels and particularities

In planning theory, these issues have been discussed in relation to the implementation of two categories of plans: those superior to the detailed plans and those used to implement building projects (Faludi 1987; Davies et al. 1989). While superior in terms of public law, the former will typically be directed mainly at subsequent planning decisions at lower levels. They may also induce revisions of existing plans or instigate the preparation and adoption of new plans. Typically, they set out in general terms the objectives of planning and their territorial scope may be the whole or a regional part of the national territory. How such plans have contributed to planning at the lower levels should in principle be evident both in the planning decisions made at those levels as well as in the spatial structuring of actual building activities.

For the other category of plans, on the lowest and detailed level, the regulations will normally be legally binding for the building control, directed also at private parties. The practising of this control should materialise in the physical surroundings, which should contain elements that can be traced back to plan maps with regulations. Accordingly, the planned physical outcome will appear after implementation as a conform and enlarged depiction from the detailed plan (Faludi 1989). How planning on the detailed level will follow up issues relating to planning on superior levels and the interplay between these levels will obviously have consequences for the physical outcome (Limb et al. 2020). For instance, it can be asked whether or to what degree the superior plans have contributed to the regulations and the outcome of the detailed plan, alternatively how challenges in detailed planning and the implementation of the detailed plans will be influencing the implementation of existing superior plans and the need for revisions of such plans.



Over time, legislation that regulates the changing physical environment will itself change. This applies to the planning and building acts as well as related areas of law, such as environmental law and the law of natural resources, which may be subject to change at a different pace and for different reasons (Zweigert and Kötz 1998). Legislation can therefore hardly work as a comprehensive and coherent institutional device for regulating land use, built-up structures, and buildings *over time*. In the temporal dimension, at least, there is no choice but pluralism. Existing rules need to be updated and amended partially for new legislation and amendments of existing laws. Such changes can not only redefine the respective authorities' responsibilities but may also introduce changes in the coordination and coordinative procedures between authorities. Such changes represent the rule rather than the exception in Norwegian planning history.

One well known example is the obligatory ministerial confirmation of urban plans according to the Building Act of 1924 (Sec. 27 no. 4) (LOV-1924-02-22-2) and of the corresponding development plans after the following Building Act of 1965 (Sec. 27 no. 5) (LOV-1965-06-19-7). The 1985 Planning and Building Act changed this obligatory procedure (Sec. 27-2 no. 2 and no. 3 last subsec.) (LOV-1985-06-14-77) and introduced a system where final adoption of plans would usually happen at the municipal level. However, the adoption decision would effectively shift to the ministerial level if state sectorial authorities, the regional municipality, neighbouring municipalities, or the ministry itself, had objections. As a result of such changes, new variants of planning can appear, as well as new planning tools. Moreover, plans or policies not regulated by planning law can be introduced and the planning process itself might change. One consequence could be the emergence of planning variants and self-composed procedures for dealing with such variants. In addition, shortcomings observed in the main system can induce other legislation to strengthen the existing variants within the main system or strengthen existing sub-systems or establish new ones. Such changes will tentatively not only be related to planning within the territory where the legislation prevails, but also be dependent on the legislative tradition.

The aim in the rest of this paper is to explore how the ordinary PBA-system for planning and building is territorially and functionally delineated and coordinated towards other legislation for regulating spatial planning and development. Legal information in laws and regulations supplied with referenced sources will be discussed in relation to planning practices in Norway under the headings: *the evolution of the planning territory, planning of infrastructure, natural resources for economic development* and finally *planning for protection and preservation, cultural heritage, and nature*.

## 2. The planning territory

The actual legislation for planning and building in Norway is as in other comparable states a result both of the legislative evolution in question and local government reforms. Not many years after the double monarchy Denmark-Norway was dissolved, the first building act for Oslo was adopted in 1827. Successively throughout this century similar legislation was implemented in the largest towns and cities (Jensen 1980). Such separate and local

legislation was eventually, in the years before 1924, merged and updated into one building act for the whole country. The 1924 act contained rules for urban planning at detailed level, but its legal territory was limited to the country's urban municipalities.

In case urban settlements appeared in the neighbouring rural municipalities, special legal arrangements could be implemented. The first countrywide act, including urban as well as rural municipalities, was adopted in 1965. This act contained rules for what today can be understood as planning on regional levels. And for the municipalities, rules for planning on both superior and detailed levels were introduced, although for the latter mainly based on the legal content from the 1924-act. This extension of the functional content into planning was not reflected in the title of the Act, which still was limited to building. However, the new legislation was directly described and explained in books for professional-political use in municipalities and for students under the title “planning and development” (Hansson and Tofte 1968; Johnsen 1968).

Essential parts of the 1965-legislation were forwarded into the planning and building acts that came later, also the existing one from 2008, currently in force. An important idea behind the regulative approach is to control building activities and regulate built-up structures as an integral part of spatial planning at any level. Hence, planning activities should not be legally separated from the assessments of how to build and how to fulfil requirements for building quality. It is this legislation, with its organisational and institutional preconditions for planning and building, that the central planning- and building authority of the country characterises as the “planning system” (Nordregio 2016). This is the case both for the planning and building act from 1985 and for the existing one adopted in 2008. However, both came into force for extended territories, as the scope of spatial planning gradually expanded into the coastal and sea areas.

The 1985-act explicitly included planning in waterways within its scope and extended the scope beyond the shore to the so-called *baseline*. This line or border delineate coastal states' boundaries towards the sea. Provided that no exception is stated in bylaws, it follows the low-water line along the coast as underlined in the Territorial Waters Act (LOV-2003-06-27-57), Sec.1 third subsec. A straight Baseline will usually be the most practical one (also for juridical reasons) and particularly for states with a topographically fragmented coast consisting of small islands and skerries, like Norway, cf. Figure 1. As the name indicates, baselines constitute the delimitation of coastal states towards their different zones in the sea, as the *Territorial Sea* immediately outside the baseline, then follows the *Exclusive Economic Zone* towards the High Sea. The baselines are of particular importance for the delimitation of zones between coastal states who agree on the use of the *Equidistance Principle* for determining the national borderline between the states.<sup>1</sup>

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<sup>1</sup> <https://snl.no/grunnlinje> (2022-08-06)



Obviously, the legislation will decide the authority in formal position for planning and building. However, all the practical considerations that might occur in planning and building processes can also have an impact on how these rules should be applied. How uniform and equal the rules will seem when interpreted and applied can therefore to some extent depend on how this coordination should, can or is executed, and the possibilities for negotiations between authorities involved in all such modal situations. In practice, some kinds of activities are more important than others for the authority in question, require higher levels of or special professional competence for preparing inputs for final decision, or can more easily be managed according to an alternative procedure, for example activities of national importance or development projects with far reaching consequences. Depending on the situation, it might therefore be easier to make exceptions from the main procedures in the PBA and shift to alternative frameworks from other legislation.

### 3. Planning of infrastructure

Infrastructure is understood both as technical infrastructure, facilitating planned physical activities on the land, and social infrastructure, facilitating planned human activities on the land.<sup>2</sup> In the latter meaning, the term can be used to characterise the production of any kind of service necessary in society, like schools, kinder gardens, elderly homes etc. Most typical of its first meaning is water, sewage, energy, telecom, and IT networks, roads, rail, harbours, and airports. Traditionally, access to roads, water and sewer lines has been a requirement in planned areas for getting building permission. This condition is also formulated in the existing PBA, Sec. 18-1 first subsec. a), b), c). Planning of infrastructure as such can therefore not be regarded as an integral part of the ordinary urban and regional planning authorities' obligations. Planning based on tools and procedures of the ordinary land use planning have been sufficient.

In parallel with the evolution of the legislation for planning and building, there existed laws and there were new laws adopted for planning, building, and running infrastructure. The first Road Act after Norway's exit from the Double Monarchy with Denmark in 1814 was adopted in 1824, three years before the first (urban) Building Act. The first Railway Act came in 1848 and was amended several times after that. New Road Acts came in 1851 and 1912, while the existing one came into force in 1963. Both categories of infrastructure legislation were applicable to the whole country and had been in force for almost 80 years before the first Building Act came into force for urban areas nationwide.

When planning and building acts started appearing at the national level, coordination with infrastructure legislation became necessary for handling conflicts and contradictions, both between the different interests and the different pieces of legislation involved. Should such conflicts prevent the fruitful adoption of plans or hinder necessary infrastructure projects, more authoritative formulations for implementing the constructions would be required,

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<sup>2</sup> <https://snl/infrastruktur> (2022-08-06).

involving interventions from superior authorities at the national and possibly the parliamentary level. Alternatively, one might also choose to exclude certain requirements and procedures from planning law when applying it to infrastructure projects, to prevent the impasse that might otherwise result. Based on the comprehensive perspective that is well known in spatial planning, legislation for infrastructure planning would now be named “sectoral acts”, and their coordination with the planning and building acts became a matter of ongoing interest to the legislator (Planlovutvalget 2003).

A limited part of the PBA is valid for planning of roads and railways. Both according to the Road Act and the Railway Act, the PBA shall in principle be used also when planning for infrastructure pursuant to the sectoral acts. This applies to all types of publicly owned roads, at the national, regional, and local level. Included in the definition of the road area is also possible terminal constructions necessary for the traffic on the road such as parking, space for storages, quayage etc. See the Road Act (LOV-1963-06-21-23, Sec. 2, first subsec., Sec. 12, Sec. 1, second subsec.). Similar rules are in place for planning the railway, which also includes all rail constructions, and constructions for signals, security, energy end communications (Railway Act, LOV-1993-06-11-100, Sec. 4 second subsec., cf. Sec. 3, first subsec. a). Although the rules for planning are nominally those of the PBA, both building of roads and railways are excepted from the building permission requirement that facilitates building control (Regulation for building applications pursuant to the PBA, FOR-2010-03-26-488, Sec. 4-3, first subsec. a), second subsec. a), b). This also implies that necessary additional constructions to the ordinary road and rail areas may be exempted from the ordinary building requirements regarding space and volumes, both permanent and temporary.

Organising rules for building or planning of private roads are not included in the rules of the Road Act (Sec. 53, first subsec.). Private roads are all roads that are not public i.e., without public owners. They can be designed for motorised as well as non-motorised traffic. Planning and building of private roads are mainly based on legislation for management of natural resources in agriculture and forestry (Forest Act, LOV-2005-05-27-31, Sec. 7, cf. Regulation pursuant to the Forest Act and the Land Act, FOR-2015-05-28-550, Sec. 1-1, Sec. 1-2, Sec. 1-3). Building and rebuilding of agricultural roads and forest roads require approval from the municipality. For building such roads longer than 5 km, an environmental impact assessment is necessary before deciding on the application (cf. last mentioned Regulations, Sec. 2-1 first subsec., Sec. 2-2 first subsec., cf. Forest Act Sec. 7 first subsec. and Regulation for building applications pursuant to the PBA, Sec. 4-3 first subsec. e).

In land use planning, particularly when planning for technical infrastructure is involved, approval from the Norwegian Environmental Agency is needed. These authorities are required to coordinate their investigations and decisions with the planning authorities (Pollution Control Act, LOV-1981-03-13-6, Sec. 2 no. 2). The aim is that planning, and pollution control legislation should be used actively to avoid or limit challenges engendered by pollution and waste. For planning, this implies that one must consider whether approval of polluting activities should be evaluated while planning for extensive areas or dealt with

when the application for a specific project or activity appears. Should the polluting activity violate rules and regulations based on plans according to the PBA, the pollution control authorities can only issue an approval based on the Pollution Control Act if the planning authorities agree (Sec. 11 fourth subsec.). Permission according to this act can therefore be obtained even in conflict with the existing regulatory status within a planning area.

Planning and building projects in the energy sector that require a license from a ministerial authority or the national energy directorate represent the most extensive and consistent curtailment of the PBA's and the municipal planning authorities' formal competence. This applies to pipelines in the sea for transport of petroleum (Sec. 1-3, first subsec.). It also largely applies to constructions for the electricity grid, although here the PBA's rules on mapping and documentation, as well as environmental impact assessment, respectively PBA's Ch. 2 and Ch.14, do apply (Energy Act, LOV-1990-06-29-50, Sec. 3-1, first subsec. and third subsec.). To a somewhat lesser degree, the situation is similar for constructions for energy production, which are in practice usually exempt from planning pursuant to the PBA and are always exempt from the building regulations (Regulation for building applications pursuant to the PBA, Sec. 4-3 first subsec. c).

Planning pursuant to the PBA is not a legal requirement before constructions for energy production can be built, as it normally would have been if the constructions could substantially affect the environment and society (PBA sec. 12-1, third subsec.) Legally, the local planning authority can still make spatial plans that regulate or prevent constructions for energy production, or they can withhold necessary dispensations from existing plans. They may even be required to do so in some cases, pursuant to other rules in the PBA regarding the planning authorities' own duty to plan. However, in these situations the ministry can quickly intervene by deciding that any license for energy production is immediately to be regarded as a state land-use plan pursuant to the PBL. If the ministry decides that the license should be recognised as a state plan in this way, the municipality has also lost the formal opportunity to raise an appeal against the ministerial plan decision (PBA, Sec. 6-4 second and third subsec.). The Energy Act – pursuant to which the development licenses in question are usually granted – thereby creates an obvious limitation on the PBA's otherwise quite strict requirements for planning. Moreover, it imposes a severe limitation on the municipal planning authority, resulting in a de facto abrogation of its planning powers in relation to the energy sector (in practice, if not strictly speaking in law, since it still depends on ministerial intervention).

Licensed development projects according to the Energy Act, Water Resource Act (LOV-2000-11-24-82) and Waterway Regulation Act (LOV-1917-12-14-17) are all clearly enough exempted from the requirement to prepare a development plan pursuant to the PBA. However, the sectoral acts themselves require planning, resulting in detailed plans that are somewhat similar in scope and content to detailed spatial plans pursuant to the PBA. While the license for the development can be granted before the detailed plan has been approved, the building works must await approval also of this planning document, which is more similar to a spatial plan than the development license as such.



#### 4. Natural resources for development of primary industries

Immediate utilisation of natural resources, renewable or not renewable, are of particular concern in spatial planning: For the nature itself and the society, resources are usually land-fixed and should maintain certain qualities for direct human use. Economic development presupposes some kinds of profitability, but to maintain it over time, the resource must not be over-utilised and spoiled. Such considerations may challenge the understanding of exactly how resources over time represent economic goods for profitable production, which at the same time can conflict with existing activities. Utilisation of natural resources will, so to speak, at any time give rise to issues where planning can hardly escape from the realm of speculative considerations, regarding a multitude of possible uncertain and certain profitable schemes.<sup>3</sup>

A possibly profitable occurrence of a resource must first be found and evaluated before planning and projection for production can be undertaken. Examples of how such preliminary situations are regulated can be found in the Mineral Act (LOV-2009-06-19-101), which regulate activities for mapping surveys of mineral resources for possible exploitation (Sec. 3 first subsec., cf. Sec. 1). Territorially, its legal domain is limited to the delineation of private property rights towards the sea. But there are formal possibilities for investigations of mineral resources under the seabed through constructions installed on shore. Permissions pursuant to the Mineral Act do not, however, obviate any requirements that may follow from other legislation, including the requirement for a spatial plan pursuant to the PBL (Sec.4 second subsect. and Sec. 5 first subsec.). The planning requirement in the PBA can in consequence result in parallel preparation of a development plan, alongside an application for a license. However, as before, licensed stone quarries, gravel pits and mines with related works are exempted from the building permit requirement (Regulation regarding building permits pursuant to the PBL, Sec. 4-3 first subsec. g)).

For aquatic industries in sea waters, both within and outside the territorial scope of the PBA, there are other challenges, authorities, and procedures to consider. Natural resources can lose their attractiveness over time, they can move or drift away, or alternatively the technology for exploitation can be changing, etc. Like mineral resources, aquatic resources can also be exhausted or replaced by the development of other products. However, there is no clear parallel to planning in terrestrial areas or even to planning for exploitation of position-fixed mineral resources. Sea water biological resources are not land-fixed in the way minerals are, as underlined by Kidd and Ellis (2012). This should be considered even when they are located inside the authority area of PBA.

Those who want to establish aquatic position-fixed industry must according to the Aquaculture Act (LOV-2005-06-17-79) acquire ministerial approval (Ministry of Trade, Industry and Fisheries) and then register this industry, and the ownership (Sec. 4 first and second subsec.). The procedures for this will involve several central state and regional

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<sup>3</sup> <https://snl.no/naturressurs> (2022-08-06).

authorities where one important condition for registration is to meet environmental requirements: The industry must be environmental safe and conditions in this act imply that permission may not be issued in conflict with existing land use plans pursuant to the PBA (Sec. 15 a,b,c), existing protected environments according to the Nature Diversity Act (LOV-2009-06-19-100), Ch. V, or protected cultural heritages sites (LOV-1978-06-09-50, cf. Ch. II, IV, V). Still, sectoral permission can be granted provided that the planning and/or protection authorities agree on an individual basis, in which case subsequent changes to the relevant spatial plans and environmental protection orders may be expected, even though it is not guaranteed. In addition, ministerial evaluations should be implemented according to the location. One issue will be the need for land to the industry under planning, another issue will be alternative aquatic uses of the same area, and other uses of space and protection interests not included in the Aquaculture Act, Sec. 15 b and c. A last condition is that necessary permissions should be issued according to the Pollution Control Act, the Water Resource Act, the Food Act (LOV-2003-12-19), and the Law on Ports and Waterways (LOV-2019-06-21-70). Unlike the rule regarding the PBA, which is negatively formulated as a requirement that there should be no conflict with existing plans, these final provisions are positive requirements for express approval.

Complexities of rules under the purview of several authorities on different levels engender possibilities for diverging interpretations of the legal basis and forth and back procedures before a final and implementable decision is reached. This also applies when it comes to building of installations and constructions for use in the aquatic industry. Yet again, a building application is normally not required for floating constructions in the sea. (Regulation regarding building applications pursuant to the PBA, Sec. 4-3 first subsec. f). This is also the case if these constructions are to be placed inside the geographical scope of the PBA, i.e., less than 1 NM outside the Baselines. In these areas, with a topography consisting of open water surfaces, islands, and skerries, planning of such constructions will be a variant of the ordinary land use planning on the mainland.

Contradictions in the legislation for more coordinated planning in these parts of the country can more easily be understood from challenges in its close law-making history (Myklebust 2018). Diverging interests locally, and conflicts between and within central state authorities, their regional counterparts and various professional bodies, have all had an impact on the legal formulations, engendering some plurality of legal opinion and interpretation. Moreover, many have been working as watch dogs in aquatic planning for these areas (Stokke 2017; Jørgensen and Kjørsvik 1995). In the long term, there is obviously a parallel with the emergence of public planning in other areas historically and its emergence in the form of what is today understood as “ordinary” urban and regional planning (Smith et al. 2011; Retzlaff and LeBleu 2018).

While mineral extraction and aquatic industry are situated in the periphery of PBA’s spatial domain, areas for agricultural production are found in its core spatial sphere of influence. Here the traditional land use conflicts between biological production and development for urban purposes prevail. The Agriculture Act (LOV-1995-05-12-23) will, particularly within



the existing planned areas, restrict the possibilities to convert both actual and potential agricultural land to building purposes, and in these regards also restrict subdivisions of agricultural property (Sec. 9 first subsec., Sec. 12 first and second subsect).

Within the area of existing detailed development plans, there are exceptions from the rules regarding conversion to development and subdivision for all kinds of land use purposes except agriculture and forestry, and zones regulated for special considerations concerning safety, noise, and danger. For the municipal land use plan, the same applies for areas regulated for building purposes, constructions etc, or for rural areas (dispersed settlements) regulated for agriculture-forestry, nature/open air areas and in addition areas for domestic reindeer. But for the latter, a development plan must be adopted before possible building application (Sec. 2 a) and b) no. 1,2).

In these procedures, discussions from both sides will be based on legal arguments justified by policy stands. Information from both parties and especially the planning authorities' participatory procedures towards the actual agricultural authorities and organisations will in general contribute to moderate contradictions and perhaps lead to agreements both during the plan preparations and in regards processing of the final plan.

## 5. Protection and preservation – cultural heritage and nature

The country's first law on legal protection of buildings was adopted in 1920 and for the protection of nature in 1954; this means they were both passed before a common building act for all urban municipalities came into being and before the Building Act for the whole country came in 1965. The earlier protection legislation has more or less been transformed into the formulations of existing laws for both cultural heritage and nature diversity.

This overlap is to some degree rooted in the planning and building authorities' obligation to cooperate with sectoral authorities that will have interests in actual planning and issues under discussion, including in most cases the county governor's office, which is both the chief state representative at the regional level and one of the main responsible bodies for a range of different sectoral acts. The planning authority must ask for inputs and opinions in issues under the respective sectoral authorities' responsibility (PBA, Sec. 1-4). In line with the purpose of the PBA planning [...] "shall facilitate the coordination of central government, regional and municipal functions to provide a basis for administrative decisions regarding use and conservation of resources." (Sec. 1-1 second subsec., cf. Sec. 3-1 first subsec. b). In practice, the county governor coordinates parts of the process, underscoring also the latent tension between municipal, regional and state levels of authority and democratic accountability in the planning domain (Vedvik 2023).

The general requirements for a planning programme with updated information on the process and priorities within the planning area can be used for giving justifications to prioritise conservation and protection (Sec. 4-1, Sec. 7-1, cf. Sec. 8-1 first subsec., Sec. 10-1, cf. Sec. 11-1 second subsect.). Planning in line with the intentions of the PBA can then regulate for protection in cases when the protection authorities fail to do so. In any case, the

most obvious possibilities for protecting specific constructions or uses of land, is to apply the statutory land use purposes for the specific type of plans, like the municipal land use plan and development plans (Sec. 11-5 third subsect., Sec. 12-1 first subsect., Sec. 12-5 second subsec. no. 5, Sec. 12-7 no. 6). In all these cases, planning according to PBA can support, but also replace, the use of the ordinary protection legislation.

The Cultural Heritage Act is territorially limited to parts of the physical environment of Norway that show signs of human activity and indicate a cultural heritage or identity. It is against the law to initiate measures that are liable to damage or cause any harm to monuments and sites automatically protected under the act and even to create risks that such harm will happen (Sec. 3 first subsect., cf. Sec. 4). The actual protection authority should in such cases be responsible for the evaluation of judgment of the damages. If someone wants to initiate activities that can have some impact on automatically protected objects, they shall inform the authority at the earliest possible moment before the activity starts. The authority shall then decide whether, and if necessary, how the activity should be implemented. Obligatory investigations are also necessary in planning of public and large private projects. In such cases, the plan must be sent to the cultural heritage authority for review. The project implementation cannot start if the plan is under review (Sec. 8 first subsect., Sec. 9).

In the coordination towards PBA, there are exceptions for building activities that are in line with development plans (adopted after the Cultural Heritage Act came into force). The same applies for the municipal land use plan in areas devoted for building purposes and constructions, provided that the protection authority has consented to this land use (Sec. 8 fourth subsect.). In these cases, the planning authority demonstrates the active use of the legal possibility to regulate for protection of the cultural environment both on overall and detailed planning levels, cf. above. Besides, planning according to the PBA does not necessarily represent a threat against protection in all the situations regulations and plan maps are lacking any clear intention to protect. There might still be solutions for protection measures without manifest expressions in planning programmes, land use objectives, provisions to the plan etc.

The cultural heritage authorities can through individual orders protect buildings, constructions etc. that are not automatically protected due to age (normally older than 1537). Included for this protection can be, as for automatically protected structures, sites necessary for maintaining the impressions of the protected object in its environment. For already protected objects including ship finds, it is also possible to protect the immediate surrounding area to conserve the impression of the object in its environment. The ambition to secure the scientific interests related to the object is part of these interests. In addition, there are possibilities to protect cultural environments including natural elements to preserve the value of cultural environments to cultural history (Sec. 15 first subsect., Sec. 19 first subsect., Sec. 20 first subsect.)

The Nature Diversity Act is based on different rules for delineating its legal territory compared to PBA. This is the case with regards to lakes, waterways, and territorial waters (Sec. 2 first and second subsec.). Territorial waters includes both the *Internal Waters* and the *Territorial Sea* divided by the Baseline. The Territorial Sea includes the sea area outside 12 Nautical Miles from the closest point on the Baseline (Territorial Waters Act, Sec.1 first and second subsect. and Sec. 2 first subsect.). This latter legal territory includes the sea and the seabed with underground and aerial space above the sea. Ch. VII in this Act (about access to genetic materials) is in force for the polar islands Svalbard and Jan Mayen as well.<sup>4</sup> For these islands, the Parliament can decide according to the same section that other rules within the Act should come into force. And the same section gives legal force to 18 sections to the continental shelf and Norway's economic zone<sup>5</sup>, if they should be found suitable (The Economic Zone Act, LOV-1976-12-17-91) The concerns are mainly related to the legal purposes of the Act, areas of effect, sustainability, biological management, and access to genetic materials.

Management of nature's diversity based on this Act imply that its rules and regulations will be used directly for regulating material purposes, as in planning and building matters (Winge 2013). The Act introduces a general attention to using its aims and purposes in actual operations without regards to other legislations and authorities. The purpose is to avoid negative impacts on nature's diversity in line with the understanding of the different objectives for the management of various types of nature, ecosystems, and species according to sections 4 and 5 of the Act. If the implementation of activities takes place pursuant to permissions granted by public authorities, the duty of care requirement of the Nature Diversity Act should be regarded as fulfilled, provided that the reasons for granting the permissions remain relevant (Sec. 6). This set of rules creates yet another variant of how considerations on protection can be incorporated in planning and building control. The Nature Diversity Act require attention to its defined objectives while the Cultural Heritage Act is largely based on specific legal requirements pertaining to what can be done at specific sites.

Establishment with delineation of protected areas according to the Nature Diversity Act is based on specific investigations and formulations for the actual purpose of protection. The protection documents are adopted as regulations by the Parliament (Sec 34 first, second and third subsec.). The Nature Diversity Act contain, in sections 35, 36, 37, 38 and 39, five different categories of territorial protection: National parks, areas for protection of the landscape, nature reserves, areas for biotope protection and marine protection areas. Between these five types of areas there is some overlap with cultural heritage protection. In the first category, cultural heritage objects can be included to avoid deterioration or damage caused by pollution and development or other human activities. The same is largely the case for protection of landscape as such where also cultural heritage protection can be included.

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<sup>4</sup> <https://snl/sjøterritoriet> (2022-08-06).

<sup>5</sup> <https://snl/kontinentalsokkelen> (2022-08-06).

And for nature reserves, provisions in the regulation can be used for protection of cultural heritage objects inside the area (Sec. 35 second subsec., Sec. 36 first subsec., Sec. 37 third subsec.). Additional to this kind of territorial protection, the Act (Ch. VI) can be used to adopt regulations for protection of selected or prioritised types of nature. Documentation of the prioritised objects for protection and delineation of the area will be necessary here as well. But in this case, a legally binding PBA land use plan that clarifies the use in relation to prioritised types of natural objects has higher priority than provisions in the regulations for selection, delineation, and status of the prioritised type of nature. The condition is that the plan is adopted after the sanctioning of the regulations (Sect. 53 fourth subsec., cf. first, second and third subsec.).

It is possible to apply for exemption from protection decisions. Should a project need permission both from the protection regulations and other legislation, for instance PBA, a parallel application to both authorities should be possible. In such cases, the protection authority will normally make the first decision (Sec. 48 first and third subsec.).

The main areas containing all categories of protected areas under the legal rule of the Nature Diversity Act must be expected to lie within the territory of the PBA. The legal approach for planning of this protection can therefore be characterised as a subregime to the ordinary PBA-planning, while the protection according to the Cultural Heritage Act is more comparable with a variant of the protection that is regulated in PBA. The coordinative planning that is supposed to take place locally in the first case will accordingly be moved closer to the central state authorities' responsibilities, but in a similar fashion to planning in coastal areas, with more extensive demands for cooperation and sharing of responsibilities between authorities on different levels.

## 6. Conclusions

The Norwegian system for urban and regional planning together with the building control is based on the PBA, but also depends on other legislation used for the regulation of additional kinds of development and protection. Taken together this legislation gives rise to variants of both planning and building control as well as planning for special purposes that can be based on both alternative legislation and exemptions from building control. This extended system for utilising the spatial surroundings and protecting natural resources has gradually been changing over time due to changes in legislation, but also from furthering institutional tools without strong demands for modernisation, coordination between public authorities, and comprehensiveness in use.

Within the legal domain of the PBA, we encounter exemptions and variants whereby road and rail projects are nominally obliged to apply the rules of the PBA, but are exempted from building control, also with respect to other constructions and buildings than roads or rail lines. Another variant is protection of cultural heritage, where the PBA gives rich opportunities for protection in addition to the Cultural Heritage Act. More clearly defined subsystems appear in planning for protection and management of nature diversity and in

planning for aquatic production in the coastal zone areas. In these two examples, there are different approaches towards PBA regarding delineation of the planning territory, regulation tools, formal procedures and supposedly the interplay between authorities involved.

Most clearly, planning and building of energy constructions constitute its own subsystem working to the side of the PBA-system, and largely side-lining it. Taken together this formal fragmentation of the legal systems for spatial planning and related planning process requires extensive legal coordination, which presents also clear risks to stakeholders. To make this kind of planning work more efficiently, and to ensure better coordination, transparency and stakeholder participation, it might be necessary to reduce the fragmentation, streamline the legislation, and clarify the roles and responsibilities of different government bodies.

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# Land Acquisition and Property Formation in Urban Planning

## Abstract

This paper highlights the particularities in the Norwegian planning and cadastral systems concerning planning responsibilities, the provision of land for development, and property formation and registration. The planning system gives the local planning authorities the choice of initiating local development planning including the provision of land for development, or alternatively to let this planning and provision of land be the developers' responsibility. Then the property formation according to the cadastral system allows landowners and developers to decide how the existing ownership in land together with new constructions can be transferred to the new owners. The conclusion is that the public process in question will not be a uniform step-by-step process from planning to closed sales of new properties, but a process that goes back and forth depending on the acquisition of land and how ownership of the constructions can be transferred according to the cadastral rules.

## 1. Introduction

Planning with access to land is a necessary condition for implementing building projects that end with selling or hiring of ground and/or floor space. This production of space is led by regulations and legal mechanisms, which could be either legally binding or informal, belonging to national planning and cadastral systems. The planning system provides rules for the approval and implementation of development projects while the cadastral system contains procedures for property registration; for the extinguishing of the existing property identifications and for registering of up-coming property information for the new units. In this way, ownership in real estate makes it possible to initiate and implement building projects, where the owner appears as an active force behind these changes. Only through the transformation of existing property structures will it be possible to develop the existing urban structure for new uses of ground and floor space as well as coming urban activities (Conzen 2009).

In modern planning systems, changes of existing urban structures must take place within directions set out in binding detailed plans, whether they are “plan led” or “legally binding” as in Norway. Originally both distinctions are rooted in obligatory requirements for conformance between the detailed plan for controlling development and the regulation of higher-level plans or other kinds of superior regulations (Newman and Thornley 1996).

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However, due to formal mechanisms the local planning authority might on certain legal conditions adopt legally binding detailed plans that deviate from higher level regulations. Such deviations might be justified by arguments based on flexibility, efficiency, improved results for certain target groups without loss for others etc. (Faludi 2000).

At any rate, should the local planning authority for the locality in question initiate and prepare this category of plan, the municipality might use its regulatory power to acquire land by expropriation or by threat of enforced takings. The municipality can then after such acquirements portion out land to developers as building plots for development. If the municipality desists from land acquisition, landowners and developers who lack suitable building plots for development will normally have to acquire land through negotiations or bids in voluntary sales. If it should not be clarified through the contracting, the buyers will have to convert acquired pieces of land into building plots and provide for cadastral registration accordingly. Up-dating of cadastral information is a precondition for project implementation and might be necessary for the registration of new properties.



*Figure 1: Planning and development of land procedures based on two alternatives i) straight forward planning, land acquisition, cadastral transformation and ii) land acquisitions together with cadastral transformation and then planning for adoption of the plan.*

In the following, the Norwegian planning and cadastral systems are analysed based on the figure above. Earlier investigations by Ramsjord and Røsnes 2011; Ramsjord 2014; Kalbro and Røsnes 2013 provide the main empirical background for this presentation. The point of departure is a description of how the actual planning system works as a public device for the municipalities both for urban development and land acquisition. Straightforwardly this procedure creates the conditions for land acquisition of building plots followed by cadastral registration of new properties, but as indicated by Figure 1 the process might not be so straightforward in practice. The paper therefore also gives a description of the most common way of using these administrative systems, discussed together with what motivates the municipalities to use the alternative process where both land acquisition and planning mostly will be undertaken by private parties. At the end, procedures for documentation and registration of cadastral information for the building plot are discussed.

## 2. Planning for development – urban structure vs. land use

### 2.1 The urban structure

In planning, the authority must consider where and when new constructions could be built, how the building area should be regulated for the layout and design of buildings. Within these perspectives, planning objectives are directed towards the urban physical structure. This structure as it appears in the spatial organisation of ground- and floor space is an outcome of property transformation. Formation of building plots in land and of new properties produced through building projects create in solid terms conditions for the evolution of cities, structurally as well as functionally. Land values together with access to land, and movements in the urban fabric as well as the urban structure itself through the property structure are recurring denominators for urban changes. Respectively they are associated with different theories: the bid rent theory (Alonso 1964), the configuration theory (Hillier and Hanson 1993) and the urban morphology theory (Conzen 2009). Regardless of whether cities are changing spontaneously or through planning there are implicit property related factors connected to responsibilities for urban development projects. This indicates that decisions for implementation will be based on judgments about the advantages and disadvantages inherent in the urban structure.

In general, urban structures consist of various morphological elements. *Urban morphology* should then be a precept for analysing compositions of urban structures and their capacities to meet needs for physical changes and to realise new building activities (Moudon 1997). In these structures the *building pattern* is characterised to analyse how the layout of buildings together with its *building typologies* are encircled by the *street structure* and the structure of other open areas like places, parks etc., while the topologic *structure* creates the open-air rooms between the buildings. The *property structure* with its cadastral pattern of ownership is a part of this morphological totality. The ownership structure that once represented the driving force behind the growth of the existing morphological situation can then be recognised as an initiating factor behind the changes induced by the upcoming constructions in terms of building patterns, building typologies, and the facades' iconography due to contemporary public regulations. In addition, there are *urban functions*, different categories of activities that through their use of ground- and floorspace generate flows of human experienced connections through and between the elements of the urban structure, which thereby constitute preconditions for property formations to come (Conzen 2009).

Such relationships appear on various geographical levels in the urban structure. Typically, the street structure as one of the most lasting elements will therefore also be a strong determinant for later development, for instance on the building pattern together with its urban functions. The property pattern will have certain influences upon the characteristics of these elements too, being demarcated on the ground, displayed in property maps as parcels and registered as ownership information in the ground book (Carmona et al. 2010).

Urban morphological elements that characterise relationships in the physical structure and functionally in urban activities, exist *de facto* before the property pattern can be transformed to building plots and redeveloped for coming use. This implies that planning for coming development will create terms for delineations of land for building, including the building pattern of the building plots. Because of factors related to densities in land use and property values, such structural relationships are more complex and hence more difficult to manage in urban than in rural areas. The property complex as it physically appears on the ground delineated in parcels or plots will then be more important for the development of physical structures (Kropf 2018).

## 2.2 Building plots – areas for realisation of plans or for development planning?

One of the public planning's inherent purposes is to give formal and even informal guidance for development of the urban structure through delineation of land units to be built on, i.e., *building plots*. Today this might sound self-evident. But the origin of this idea is nevertheless connected to the emergence of modern planning from the latter half of the 19<sup>th</sup>-century. It was conceived of as necessary for the public to overrule existing landowners' self-interests and to achieve objectives for urban development from which new patterns of urban structure also emerged. A close example could be Cerdà's planning of Barcelona (Martín-Ramos 2012). Challenges related to how existing ownership patterns within the planning area and for the coming building plots could be transformed and arranged ready for building of the intended floorspace were parts of the authorities' considerations. Public ambitions for controlling the future pattern of building plots had also to include not only how these areas should be delineated, but also how to change the existing property situation internally within these areas for controlling the development directed in a plan (Martín-Ramos 2012).

The term "plot" is of ambiguous origin (Kropf 2018). In a general perspective this delineated piece of land can be a registered or unregistered property unit of different size and physical form, where the ownership can consist of one or several owners and be organised differently. Separate from cadastral and ownership status this land can in planning be delineated for different building purposes. A local development plan can comprise both open land for coming constructions as well as existing buildings, which will have to be integrated in the new building pattern or demolished. The size, form and built-up content of a building plot will therefore have an impact on how the building pattern, building typology together with the formation of open space both within and towards outside areas will be. It will then affect how the future built-up area appears as a partial urban area surrounded by the existing urban structure elements. Building patterns consisting of urban carré structures or detached single blocks will set different conditions for delineations of the building plot as well as the built-up density on the plot. Likewise, the built-up density needs to be considered in relation to the building typology and whether there should be blocks or detached villas (Carmona et al. 2010; Rådberg 1988).

The Norwegian Planning- and Building Act (PBA) does not give clear requirements for delineation of building plots. Even the term "building plot" itself is not clearly used in

relation to development planning. The most relevant sentences are found in Sec. 26-1, which underline that in new property formation or change of existing property there should not be delineated “plots” that will be unsuitable for building because of their size, form, or location according to the rules of the act. Lack of relevant rules for delineation of building plots needs in this context be viewed in relation to lack of requirements for programmes for how the development plan should be realised, for instance for reshaping of existing property patterns, formation of new properties and related financial transactions.

Lack of rules for delineation of building plots and for realisation of the development plan indicate different stands towards these challenges compared to close neighbouring countries (Ekbäck 2017). However, the planning authorities can choose to regulate boundaries for formation of building “plots” as properties in land. This may be done for plots intended for detached villas or other types of small-scaled dwellings for contractual realisation of the plan, plot by plot. This procedure can hardly be followed in urban transformations where the existing ownership situation normally also needs to be transformed and prepared for the building phase (Leiknes et al. 2021).

In opposite to planning systems of neighbouring countries Norwegian municipalities are neither according to law or tradition equipped with monopolistic power for initiating and preparing development plans. The Norwegian PBA allows almost anybody to initiate detailed planning for building projects, see Sec. 12-3, second subsection. And if the initiators, like developers and private organisations, can document that they have the required competence, they can prepare such plan proposals for municipal consideration and eventual adoption (Kalbro and Røsnes 2013). When the planning authority has received a planning proposal that meets required formal standards, there should be a decision for adoption or not within twelve weeks, Sec. 12-11.

Out of all planning proposals the local planning authorities had announced for a public hearing before final decisions in 2019, around 98 per cent were initiated and prepared privately (SSB 2020). The origin of this private dominance in detailed planning is arguably to be found in (liberal) landowner and developer friendly regulatory mechanisms. The right to initiate plans for development is also found in the English planning system, but there the initiators will have to apply for a “planning permission” first (Monk et al. 2013).

### 2.3 Land use

The immediate consequences of the free right to initiate detailed plan proposals are of two kinds. Firstly, initiators of plans will in practice more or less decide both when and where within the municipal building zone plans should first be prepared for implementing projects. Secondly, because privately initiated plans usually only will comprise land under the initiator’s ownership, the border of this area will constitute the building plot, which the owner can develop in one or more building step(-s) (Kalbro and Røsnes 2013; Røsnes 2021). This way of delineating building plots will in urban areas normally settle built-up arrangements towards surrounding properties with their existing buildings and open areas.

When implemented, the new project has created changes in the urban structure that will be impacting both on the circulation of commercial and social activities as well as people's experiences in this new situation.

Publicly initiated plans are as private planning proposals dependent on ownership for deciding over the planning area. A landowner's or a developer's development project will without consent from adjacent landowners on the other hand be bound to the borders of their existing ownership.

Nevertheless, private development planning raises other challenges for the ambitions of public rule over the urban development. Compared to planning systems with public monopoly for initiating and preparing of plans the planning authorities will supposedly need more extensive regulations at higher planning levels to achieve territorial coordination of the physical urban development. On the other hand, the right to initiate and prepare plans will make it easier for developers to consider where they should procure land for development. But in doing so, this will also motivate developers and landowners to argue for their plan proposals and projects before the planning authorities.

These aspects suggest that urban development depends in part on the planning authorities' legal wriggle room when adopting detailed planning proposals that build on more coarse-grained plans that are also legally binding. This issue is related to the well-known difference between regulative and plan led systems (Booth 1996). Both have as their purpose to manage the urban development according to the authorities' coordination within a hierarchy of plans. Even though the Norwegian planning system lacks or has less elaborated mechanisms for regulation of the urban structure at a detailed level, higher-level plans and state regulations will in some cases require more extensive public involvement. Should existing regulations not allow for the implementation of desirable projects there are legal possibilities for dispensation from existing regulations. Alternatively, a new plan proposal may be adopted, possibly based on a revised version of the existing one.

In local planning the PBA regulates the use of three types of plans: the local land use plan, the area zoning plan and the detailed plan. The first one is obligatory as is in practice also the latter. All three are based on legally binding zoning tools. A new plan or new provisions adopted by the state, or a regional planning authority, will overrule previously adopted plans or provisions for the same area in case there are contradictions, and no exception is stated. This general principle is found in Sec. § 1-5, which also applies to privately initiated plans. A precondition will normally be that no higher-level authority or neighbouring municipality objects. There is no formal requirement to revise higher level plans according to the changes that will come with the adoption of new plans at a lower level. In consequence the existing local land use plans will not with certainty display a coordinated updated version of the existing regulatory status for the actual area. Hence, this legally binding plan can therefore cover "islets" of building plots regulated by the adoption of privately initiated detailed plans. A possible update of the local plan will be undertaken every fourth year.

### 3. Acquisition of land – before or after regulation for development?

#### 3.1 Public support

The area of land assembled by developers or landowners for development will be the area for their building plots and at the same time the detailed planning area. The boundaries around this land area are the outcome of the sellers' and buyers' contractual transactions in the realm of private law and usually not decided by the authorities' regulations. In this situation the developers' assumptions regarding the amount of land needed to implement a profitable project will be important both for the form, size, and delimitation of the coming plot (Ramsjord and Røsnes 2011; Kalbro and Røsnes 2013). In fragmented property structures as in urban areas under transformation, the developers will face dilemmas between time consuming land assembly from different owners to obtain the best possible configuration of the building plot and the wish for a quick decision based on what owners are willing to sell. The processing and adoption of the detailed plan are not connected to legal mechanisms that automatically contain procedures for the adjustment of this area neither for necessary cadastral changes nor for new building activities.

Assembling land from several owners will usually complicate the acquisition process. When a development plan proposal reaches the planning authority for the approval process, the delineation of the building area can also deviate from the authority's assessments regarding the plot's size, delineation and form and the existing area's suitability for the indicated project. Should the planning authorities want another delineation, they can prepare an alternative development plan or require an adjustment of the planning area. For the planning authority this will entail more extensive commitments than just processing the planning proposal for possible approval at the end.

Requirements for an extension of the building plot can imply that the municipality must follow up on the developer's potential land purchase and possibly may have to support this extension by threatening expropriation or even implementing it. Public demands for adjustment of the boundaries and sizes of the coming building area delineated by a private proposal for a development plan are initially based on the assumption that the plan will be adopted for implementation of the project. In this case, requirement for adjustments can be regarded as public support both for the sufficient private supply of development land and for the enforcement of regulations that are more specifically directed to the future development of the urban structure.

Traditionally these kinds of challenges to detailed planning have been met by the planning authorities with expropriation. When the first Norwegian Building Act for all urban municipalities (1924) was revised in 1947, Sec. 41 no. 3 stated that unbuilt "plots", which according to their location and existing legal regulations are unsuitable for development, can be expropriated by the municipality to obtain appropriate "plots". With the Building Act in 1965 an amendment was made stating that the building committee from now on could demand that applicants for building permits should acquire limited pieces of land for giving

the “plot” a more suitable delineation or form, Sec. 39 nr. 2. In such cases, the applicant could have the committee’s consent for expropriation. The content of these legal sentences was copied almost word by word into later planning and building acts, as it presently can be read in Sec. 16-6 first subsection of the current PBA.

The legal regulations referred to above were formulated with more than sixty years apart. Over this time-span general economic and social changes occurred as part of urbanising processes and can be observed in the building and property sectors as well as in the property markets for land and floorspace. Probably the more intensive use of the right to initiate private development plans with its impact on the public acquisition of land are outcomes of these changes, which will now be addressed in some further depth.

### 3.2 Municipal provision of land for development

In the light of later planning history, the legal instruments mentioned above can be understood as originally resulting from a broader acceptance of the use of eminent domain to provide land for housing and other kinds of developments. Although the later post-World War II period gradually faced new trends, the housing capacities in the nation were still not sufficient to meet demand because of lasting needs for upgrading the existing housing stock and the general urbanisation. In addition, there were convincing arguments for local public control of the urban development patterns and the following up of housing policies including production of dwelling types, housing standard and categories of tenure (Sørvoll 2011). Such commitments gradually faded after the late 1970-ties. In recent times municipalities’, or other public entities’ efforts to provide land for urban development have mainly been dependent on the amount of land required for the public sector’s own building needs (Nordahl et al. 2011).

There are several reasons for these tendencies. Basically, Norwegian cities are young compared to continental urban history. The observed changes in land acquisition are taking place at a time when urban spatial growth is also about to change from an outward expansion on unbuilt open land and to a search for already built-up areas to be transformed to higher densities due to shifts in planning policies. Potential developments will raise the value of land in these areas. In other areas, once attractive land for urban development can lose its appeal, for instance because of inconvenient locations, rising infrastructure costs or stricter public regulations (Røsnes 2018). Under such circumstances municipal capacities to manage risks related to land markets will be challenged, both for land the municipalities already own and for land they prospectively consider purchasing. An “active” municipal policy for land acquisition could then result in losses or highly uncertain payoffs. In addition, of course, there could be uncertainties about gains and losses in the longer term. For the municipal land acquisition these conditions would require both competence and capacity to manage risks. Approaching these circumstances, the municipalities left responsibilities for both land acquisition tasks and formulation of detailed development plans to the developers. For the developers both acquiring land and preparing plans could be arranged through contracting procedures. And the local planning authority could be satisfied with exercising their



regulation authority over developers'/landowners' plan proposals and building applications. The rights to initiate detailed planning and to prepare such plan proposals for public handling then turned out to be the key changing factors within planning as well as in the acquisition and production of land for development.

The history of planning can certainly give some explanations as to why the municipal initiatives to provide building land gradually faded away. Still, an active local policy for land acquisition can give certain advantages, particularly in this context for property formation. A municipal expropriation procedure will normally start with the preparation of a detailed development plan. This planning area for expropriation can comprise land from several properties. The taking of property rights for public ownership will extinguish existing property structure as well as existing ownership rights and transfer the registered sole property rights in land to the expropriator. The expropriation will then abolish both the existing ownership and wipe out the internal cadastral registration according to this new situation. In consequence the necessary cadastral transactions that follow an ordinary transfer of ownership can be avoided. Expropriation can, depending on the ownership situation, both contribute positively to the current policy ambitions for housing and building and at the same time simplify necessary cadastral procedures. It will enhance public control over urban development patterns and strengthen the realisation of plans as a part of this control over the housing complex. At the same time, this procedure can be conducive to the developers' and landowners' efforts to clarify the cadastral situation before preparation of the plot area and the start of construction work (Nordahl et al. 2011; Ramsjord and Røsnes 2011).

#### **4. Cadastral transformation and property surveying**

##### **4.1 The building plots**

The existing cadastral situation within potential building plots is a result of earlier property transactions. In the Norwegian cadastre, a variant of German type, this historical record applies both to the identification of parcels originating from earlier properties and to the ownership rights such as covenants and mortgages. Depending on the developer's land assembly, a potential building plot can consist of one or several registered parcels that are already owned by the developer. Regardless of the historical record, this implies that the registered cadastral notifications within the detailed planning area, alias the building plot, should be deleted before the new property situation under the new owner can be registered in the ground book. This situation typically occurs in urban areas when land is reused under previously fragmented ownership. If a coming building plot is composed of several cadastral units, the developer as buyer of this area must request the merging of these units according to the Property Registration Act (PRA), Sec. 18. (LOV-2005-06-17-101).

Should the historical record within the ground book or informally among parties involved reveal that there are ownership rights belonging to other properties or persons the possibilities for obtaining a building permission become more complicated. Formally, such



rights in terms of covenants and mortgages are registered on the serving property. But registering in the ground book is not obligatory for having a valid documentation between concerned parties either regarding formation or transfer of ownership. Another peculiarity, related to planning and property law is that such rights are not automatically abolished or more specifically modified by legally binding regulations of a plan if there should be any contradictions. Since there is no time or obsoleting limits for real, i.e., not personal, covenants or general requirements for renewing after a certain number of functioning years, the information on these once registered rights will accumulate in the registries. The historical documentations can therefore span over long periods of time and include both technologically and economically outdated rights as well as rights that can now be replaced by more convenient arrangements (Mjøs and Røsnes 2021).

The PRA, Sec. 15 first subsection states that shifts of rights of ownership, mortgages and concessions over land will need documentation and declarations from the holders of such rights before the transfer of property can be completed in the registration system. Obtaining a building plot free from such rights or bonds might therefore also be a condition before a building permit can be issued.

Normally, the developer or buyer of the land will have to prepare for the necessary cadastral changes both internally on the building plot and its boundaries with surrounding properties. In practice, the internal reformation of ownership rights and the determination of property boundaries around the building plot will have to be conducted separately. As planning and property legislation does not distinguish clearly between property formation and registration, when the property first is established, the procedures turn out to be unclear and not well coordinated for their users, including the authorities (Dyrkolbotn 2021).

#### 4.2 The going around procedure

Developers and landowners can in cooperation modify the straightforward procedure for cadastral clarification of the building plots. Rather than direct formal registration of the developers' new ownership the seller (-s) and buyer involved can choose to postpone the property transfer from the initial landowner (-s) until the production of space and buildings is completed and the formation of the new properties has taken place for completing sales of these new properties to their respective new owners. The common mechanism for succeeding with this type of building plot transfer is through the use of combinations of call options and various kinds of security assignments which allow for circumventing the formal registration of the developer's ownership (Bjaaland and Nielsen 2009). The existing owner is still the formal one notified in the ground book. The cadastral transfer of the new properties as products of the building process can then take place directly between initial landowner and the buyers of these new properties. The actual use of such informal mechanisms demonstrates that, in these cases, changing of the existing cadastral status of the acquired land is not a necessary condition for having a successful transfer of ownership whether of land or buildings, to the new owners.

There is at least one essential reason why developers might prefer this going around procedure, although it has more risk (Bjaaland and Nielsen 2009). For registering property transfers in the ground book, a document fee amounting to 2.5 per cent of the property price should be paid. At the end of a normal cadastral process in two steps, the developer, whether as firm or person, can save the document fees for the first transactions, and so avoid having to pay obligatory document fees twice during the implementation of the building project. But there might also be other reasons why developers use this procedure. One of them could be to avoid the rather complicated and time-consuming procedures for cadastral re-settling of the building plot and surveying procedures related to the formation of property.

The number of occurrences of formal registered versus unregistered property transfers in connection with property development and building is unknown. Still there is reason to believe that the latter variant in real terms has been increasing during recent years both because of increasing private provision of land for development, but also because of the structure of firms within the building sector. Compared with neighbouring countries, this sector in Norway is currently dominated by small and medium-sized companies inclined to operate in their vicinities (Hagson et al. 2017). Here they can use their local information and knowledge to search for building land and find landowners with whom they can establish a trustful way to communicate and make agreements to transfer property without formal registration.

#### 4.3 Surveying before or after registration?

The PRA regulates the procedures for the determination of property boundaries. For the geographical identification of a new property, a legal delineation of the property boundaries is required, Sec. 6 first subsection a). However, there are several reasons why the owners try to avoid such early delineations of the land area of the new property. Several other properties can be produced during the implementation of building projects and might also need legal delineation before registration and transfer of ownership can occur. The developer then has to arrange for legal delineations twice, one for the building plot and a second one when the production of the new properties is almost complete. Another issue is that the terrain with its coming constructions will probably be changing during the building process. Early delineations of properties can therefore be inconvenient for surveying or later turn out to be contrary to the original intent. This can also be the case with the boundaries of building plots regulated according to the plan map. In addition, challenges may arise in connection with registering boundaries for three-dimensional property.

In order to avoid redundant legal surveys, the PRA is open to so-called postponed surveys. However, this requires a specific application from those who initially requisitioned the survey (Sec. 6 second subsection). This legal procedure seems to have been formulated for situations where the building plots are subdivided from one existing property and can be developed without substantial terrain or underground works. The reliability of existing boundary information can also cause a more extensive legal survey for the registration of

new properties in land than just for the actual plot in this case. A decisive requirement is that it must be clear from which of the existing surrounding properties this land is being subdivided. Should the boundaries of existing cadastral units of the property (-ies) be unreliable and perhaps unknown the surveying administration can, according to Sec. 10 second subsection, require surveying of the concerned cadastral unit (-s) before the legal surveying of the new property can take place. The risks of double legal surveying or, in this latter case, extended surveying, engender costs in property development. Requirements for extended surveys represent a particular challenge because of inaccuracies and faults in the Norwegian property map. The total cost of surveying will not only influence the development costs, but also where and how developers prefer to acquire land for development.

## 5. Conclusion

The Norwegian planning system and the legal procedures for formation and registration of property reveal practices that deviate from those expected for regulatory systems and property registration procedures according to a German type of cadastre. In consequence, duties for detailed planning, property acquisition and cadastral registration of the new properties do not appear as a direct, step-by-step process. For the municipalities the free right to initiate planning, and then to prepare development plans, gives strong incentives to leave both planning and land acquisition to private developers and landowners. The profit incentive will operate to bring about private action, allowing the municipality to scale down their own planning and land acquisition activities. Risks and costs related to planning and land acquisition can then be reduced, while land policy conflicts may be possible to avoid through contractual arrangements. In addition, there is a reduced need for qualified staff both regarding planning and acquisition of land. The local planning authority will therefore prioritise preparation of development plans for land areas under public ownership and for the building of constructions and floorspace of which the municipality itself will be the owner. For landowners and developers, the free right to initiate and prepare plans give possibilities to adjust the formulation of plan proposals to the design of the building project in question. They can then rely on contractual arrangements for organising this part of the process as a direct cadastral handover from the initial landowner to the buyers of new properties, but still with the developer as intermediary buyer and real owner, during development of land and selling of floor space respectively.

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# Institutional Transitions in the Land Development Domain

An inquiry into the nature of legal reforms – efficiency enhancing or redistributive?

## Abstract

Land development involves many different assessments, decisions and judgements, and the institutional designs of these rules of procedure exhibit a variation of different structures. During legislative processes it is often stated by the law-making bodies that efficiency is an important aim and motive in the establishment of new or revised review procedures. Prevalent theoretical models concerning institutional development and change can, however, be classified into two opposing traditions depending on whether they perceive legislation as allocative (value-enhancing) or redistributive in nature.

The aim of this article is to present some existing theories on institutional development and by two case studies, concerning legal reforms in Swedish legislation on land development, evaluate the explanatory and predictive capacity of these theories. The results and analysis indicate that both theoretical traditions have explanatory value and that the concept of path dependence is an important complementary factor.

## 1. Introduction

Land development involves many different assessments, decisions and judgements by a variety of authorities in disparate procedural forms. Construction of new buildings may require land use planning. Environmentally sustainable solutions for water and sewage must be designed. The road network must be expanded to handle traffic to and from the new homes. Power supply and telecommunications must be provided. In addition to planning and permit processes, land development normally also requires that the property division be adjusted, and that various land-related property rights be created, modified or repealed. Intrusions and economic losses must also be compensated.

In Swedish real property law, different institutional solutions are provided and assigned for these assessments. Planning of new buildings takes place by the municipality, through the preparation and adoption of a detailed land use plan. Examination of environmental aspects regarding water and sewage is accomplished through a permit assessment by the Land and Environment Court, or in some cases by the County Administrative Board (the regional state administrative agency). Planning and construction of public roads is a responsibility of

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the Swedish Transport Administration, through the preparation and adoption of a road plan. Electric power lines require a network concession, which is assessed and determined by the Swedish Energy Markets Inspectorate. Various forms of telecommunications may require a permit from the Swedish Post and Telecom Agency. Property formation measures are accomplished by the Cadastral Authority through a cadastral procedure. The cadastral procedure is also the most common process for creating partial rights – e.g. easements – and determining compensation for such rights or acquisitions.

The legal designs of these rules of procedure exhibit a variation of different structures. Some issues are assessed in administrative procedures, others are adjudicated in cadastral procedures or court procedures. The different assessment processes constitute alternative legal institutions, and the structural designs of these institutions play an important role in the material and procedural outcome of the issues at hand.

The capacity of the legislation on land development to meet public and individual interests in a desirable way, is dependent on the efficiency of these procedural designs. The reason for this is that *legal institutions function as filters* or connections between a society's material goals, and the results actually achieved (Komesar 1994). Choice and design of legal institutions will thereby strongly influence a society's resource allocation, cf. Coase (1960).

During legislative processes in the land development domain, it is often – or rather regularly – stated in public inquiries, Government's bills and other preparatory documents that *efficiency is an important aim in the reform work*. Promptness, flexibility, cost-effectiveness are often emphasized as motives. At the same time, legal security is usually accentuated as a counterweight. Uniformity, coordination, clarity and systematic structures are another group of objectives that are often stressed, as well as the desire to facilitate and stimulate voluntary agreements within the framework of the official assessment procedures (Ekbäck 2000 pp. 9–12). All these objectives can be seen as expressions of a desire for an efficient and transparent assessment and review system that generates materially correct decisions at low costs.

Analyzing economic properties of existing procedural designs can generate conclusions on whether the institutional systems are efficient or not.<sup>1</sup> Regardless of whether the analyses lead to conclusions of efficiency or inefficiency, a number of new questions present themselves: Why is the analyzed institution efficient or inefficient? What factors are relevant to the outcome of institutional change? The analytical perspective alters to a meta-institutional level, i.e. the legislative procedures.

Various theoretical models exist to explain and understand the dynamic development of legal institutions. The majority of these can be classified into two opposing traditions of ideas depending on whether they mainly perceive legislation as allocative (value-enhancing)

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<sup>1</sup> See Ekbäck (2000) for an in-depth law and economics analysis and interpretation of different assessment and review procedures applicable for land use alterations and property right acquisitions in the Swedish land development legislation.

or redistributive in nature. Some additional explanatory models include more randomly based evolutionary theories. A detailed account of the different perspectives is given in section 3.

The *aim of this article* is to present some existing theories on institutional transitions and by two case studies, concerning legal reforms in Swedish legislation on land development, evaluate the explanatory and predictive capacity of these theories.

The following section 2 gives an introduction to the Swedish legislative procedure in general, whereafter an overview of some prevalent theories and models concerning institutional development and change are presented in section 3. Section 4 gives some empirical indications in support of the theoretical models, including two case studies of documented legal reforms over time. Section 5 concludes the study with an analysis, discussion and some closing reflections.

## 2. The Swedish legislative procedure

Basically, Sweden has a civil law system, whose essence is manifested in its dependence on statutory law. However, unlike continental civil law systems, Sweden also relies upon authoritative judge made case-law as an important supplement to its statutes. The written Constitution consists of four fundamental laws. Apart from the principle of *lex superior*, a procedural distinction is made between fundamental laws and other laws; the difference being that any amendment of fundamental laws requires two identical decisions to be made by the Parliament (*Riksdagen*), separated by a general election. Unlike most continental European countries, Sweden's codified statutes do not include a comprehensive Civil Code (Legrand 1997). The statutory enactments are instead set forth in a piecemeal fashion.

The legislative procedure is regulated in the Swedish Constitution, which states that the Parliament is the sole legislator (see Figure 1 for an overview representation).<sup>2</sup> In a somewhat simplified form, the process can be described as follows: *Initiatives* for new legislation can come from the Government or a government agency, and through lobbying from professional and trade union organizations or from other associations. Another common procedure is that the Parliament, on the basis of bills introduced by individual members, requests that an inquiry be made concerning legislation on a certain issue. The preliminary work in the preparation of bills is normally done by commissions of inquiry, legal experts in the ministries, and the Parliament's standing committees.

As a first step the Government appoints a *commission of inquiry*. If the proposed measure has political implications, the commission will usually consist of politicians from different parties and representatives of important interest groups, presided over by a high-ranking judge or civil servant. Experts are often appointed to assist the commission. The results of

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<sup>2</sup> The specific stipulations on the legislative powers and procedures are stated in the Instrument of Government (Chapter 8) and in the Parliament Act.



the legal commission's inquiry are generally presented in a report giving an exhaustive account of the present state of affairs in the field concerned, a general justification of the changes proposed, and detailed draft proposals with commentaries on each clause. Commission reports are published in a special series known as Swedish Government Reports (SOU). To a certain extent, inquiries into matters of legislation are carried out in the ministry principally concerned, with the assistance of the ministry's own officials and external experts. These proposals are often drafted in a very concise form and are not accompanied by reasons for and against in the same detailed manner as are the traditional reports.

When a commission has finished its work, its recommendations are examined by the legislation department of the ministry concerned. The commission's report is then sent out for *written comments* by interested authorities and organizations. If the proposed legislation is of more than average importance, as many as a hundred bodies may be invited to submit such comments, and some of these may run to the size of small books. Furthermore, any citizen has the right to submit his or her views on the proposal to the ministry. On the basis of the report and the invited comments, the matter is analyzed by professional experts within the ministry. The minister concerned and the Government then adopt a position on the issue. If it is decided to proceed with the matter, the ministry will prepare a bill.

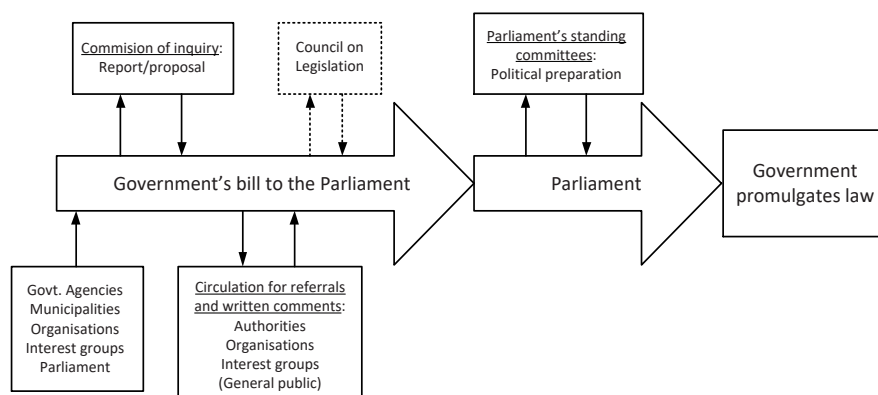


Figure 1: Summary overview of the Swedish legislative procedure.

If a bill touches on a law of importance, the Government often refers this bill to the *Council on Legislation* for its opinion. This body is composed of justices of the Supreme Court and of the Supreme Administrative Court, and the Council scrutinizes the bill from a legal point of view with particular reference to its coordination with other legislation and the quality of its formulation. After making such changes as are thought desirable in view of the Council's opinion, the Government presents the proposal as a *bill to the Parliament*.

The most important part of the Parliament's legislative work is performed within *standing committees* which are organized according to subject areas mainly following the ministerial division. Their composition reflects the political strengths of the parties in the Parliament. Every committee has access to experts within its field. The committee's work results in a

report which contains a declaration of attitude toward the bill, often accompanied by opinions from minority groups within the committee.

The bill and the report are subsequently dealt with at a plenary sitting of the *Parliament* which, after a debate, votes on the bill. The general rule is that only a majority of the Members of Parliament present and voting must vote in favor of a proposal in order for it to become a law. The Parliament's decision is announced in a letter to the Government.

Finally, the laws decided on by the Parliament are *promulgated by the Government*. The enactments made by the Government are published in an official publication, the Swedish Code of Statutes.

### 3. Theoretical models and perspectives on institutional development

A number of theoretical models exist to explain and understand the dynamic evolution and development of legal institutions. Most of these can be roughly classified into two opposing traditions of ideas depending on whether they mainly perceive legal reforms as allocative (value-enhancing) or redistributive in nature.<sup>3</sup>

#### 3.1 Allocative paradigms

The theories and models that perceive the development and change of legal institutions as value-maximizing rest on the perception of the state and Government and the legal system as parts of a treaty between the citizens – the idea of the social contract (cf. Buchanan and Tullock 1962).<sup>4</sup> The citizens, i.e. the electorate, can be said to enter into implicit agreements with each other through the general elections and other democratic procedures. The political representatives in the Parliament and the Government manifest these agreements through legislation. If we disregard potential agency problems in the legislature, such a model will predict that efficient institutions are created to minimize transaction costs and increase overall welfare.

A large part of the property rights school is a modern representative for these contract-inspired models of institutional change (cf. Anderson and McChesney 2003). However, these models have a significant weakness in that they do not explicitly include actors, processes or institutional restrictions in the legislative procedure. Institutional development and change arise through the “invisible hand” when technical, demographic or other exo-

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<sup>3</sup> Alternative models that contravene this simple dichotomy are found e.g. in Schotter (1981), Rothstein (1994 pp. 162–170) and Sjöstrand (1985).

<sup>4</sup> The utility-based arguments can be traced back in time to Thomas Hobbes' idea of establishing a state power to avoid “a war of all against all”. Natural law-inspired philosophers such as John Locke and Jean Jacques Rousseau can also be largely attributed to the tradition of perceiving that the state and the legal system should strive to increase the utility for its citizens (Duke and George 2017).

genous factors have created the economic preconditions.<sup>5</sup> The institutions of a society will depict an evolutionary development trend. In an ongoing “trial and error” process, only the effective ones will survive (cf. Alchian 1950).

The absence of meta-institutional actors and processes in these models makes it difficult to understand and explain why inefficient institutions can arise and last for a long time. A certain degree of inertia and lag can be expected when the external conditions change, but over time – in Papandreu’s (1994 p. 199) words – the system seems immune to inefficiency. The disregard of constraints and hurdles in the legislative procedure means that the meta-institutional process is assumed to work almost perfectly. Eggertsson (1990 pp. 249–271) applies the somewhat condescending term “the naive model” for the perspective.

### 3.2 Redistributive paradigms

Alternative models focus instead on redistributive effects from legal reforms. The question is, however, whether the contrasting exploitation-inspired models have a higher independent explanatory capacity. With their ideological-historical roots in the Marxist class struggle, these theories perceive the state and the legal system as manifestations of strong and influential groups in society (Hydén 1978, Stjernquist and Widerberg 1980).

The focus on redistributive effects that arise from legal reforms, and the incentives that these generate, places the public choice school as a modern representative of the approach (cf. Buchanan et al. 1980). Citizens are assumed to compete for the existing and potential resources of society, and strive to maximize the individual outcome taking into account the institutional constraints. Institutional changes take place in a political market where the elected representatives offer different groups in society economic benefits in exchange for votes, mass media support or the like (Moberg 1994 pp. 127–132). Some strong organizations and interest groups will be able to influence the legislative process more than others, thereby redistributing financial and other resources from diffuse, weak and disorganized parts of society.

This perspective can easily be connected to the Swedish legislative process as the procedure is designed. Through the system with a commission of inquiry and the consultation procedure, interest groups and organizations are given good opportunities to participate and influence, often based on a favorable information position. Organized interest groups can portray themselves as target groups for a certain reform, regardless of whether this was the purpose of the legislation or not, and present impact analyzes or side effects of a bill. The larger interest groups often have considerable resources at their disposal for investigative work, dissemination of information and campaigns. The close collaboration between

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<sup>5</sup> A multitude of studies can be listed as examples of this approach, e.g. Demsetz’ (1967) analysis of hunting rights in Native American tribes in eastern Canada during the 17th and 18th centuries. Other studies include the European colonization of the great American plains (Anderson and Hill 1975), African tribal rights under the British colonization (Ault and Rutman 1979), mineral rights in California during the gold rush (Umbeck 1981) and the agrarian enclosure reforms in England (Dahlman 1980) and in Sweden (Pettersson 1983).

political representatives and interest groups during the legislative process is an important component of Swedish corporatism (cf. Lundquist 1992).

The public bodies also participate actively in the legislative process through problem descriptions, development projects, consultation responses, etc. The classic bureaucratic theory by Niskanen (1971) concerning the administration's efforts to increase the scope of its own activities fits well among the redistributive exploitation models. In particular, the administration's large information advantage creates, together with the consultation procedure, opportunities for the related authorities to take over new areas of activity, so-called "bureaucratic imperialism" (Tullock 1965 pp. 134–136).

The design of the legislative process thus seems to provide strong and well-organized groups as well as the administration with good opportunities to influence the reform proposals in order to promote their own interests. The views expressed in the written comments during the circulation for referrals have also been shown to actually have real influence on the design of the legislation (SOU 1999:144). The exploitation or interest group models can therefore provide a credible explanation for why inefficient institutions can be observed. On the other hand, difficulties arise in understanding the emergence of institutions that exhibit efficiency.

### 3.3 Combining the one-sided models

As above, there are thus two opposing theoretical views of the impetus and nature of institutional development and change. According to the former, we can expect efficient institutions, while the latter mainly predicts inefficient solutions. Can these be combined into a joint model that simultaneously explains both how effective and ineffective institutions can arise?

North (1981) has made such an attempt to combine the allocative and redistributive elements in a model that nevertheless to a large extent rests on the idea of exploitation. Given the institutional restrictions, the aim of the groups in power is:

“... to reduce transaction costs in order to foster maximum output of the society and, therefore, increase tax revenues accruing to the state.” (p. 24)

For the groups in society that exercise strong influence over the legislation, the total production in the economy will thus limit which redistributions are politically and economically feasible. The more efficient the institutions, the more there is to exploit. An equilibrium is thus established between the allocative and redistributive driving forces, which depends on the information accessibility of the parties concerned and other transaction costs.

Another line of reasoning that has much in common with North's, forms the basis for Sened's (1997) design of his “neo-liberal theory of the state”:

“Most leaders, regardless of how powerful they are, depend on their subjects for their livelihood. The creation and enforcement of property and human rights enhances the productivity of their constituents which, in turn, allows the leading elites to live better, off this production. Greedy

leaders ‘take the money and run,’ while smarter leaders invest and wait to collect the fruits of their investment.” (pp. 178–179)

In my opinion, these models overemphasize the role of the legislator in this context, an issue I will return to shortly. Something to be noted beforehand is the importance that North (1990 pp. 141–159) attaches to the rigidity or locking to certain institutional development tracks that arise in societies over time, so called “path dependence”. Once an institutional system or structure has been established, the economic, political and social costs of making changes increase. These costs arise from several different reinforcement mechanisms. First, institutional change is associated with large fixed costs. An established institution therefore has clear economies of scale. Through learning among the actors, organization and coordination with other formal and informal institutions in society, the inertia and stability of the prevailing order is strengthened. The outcome is that institutional development and change only takes place gradually, with small incremental steps at a time. This lock-in effect means that inefficient institutions may persist for a long time, even if a change is requested by all actors in the legislative process.

The dependence to a certain development path seems relevant and important as an explanatory parameter for institutional change. If this factor is supplemented with the information deficiencies always present in a complex society of today, the effects are further strengthened. Incomplete information, on the other hand, means that the one-sided concentration on the legislator’s own preferences and motives are played down. As long as the effects of an institutional change are not fully known, the state or the groups in power, need to receive information about the expected consequences. The legislator, i.e. the political representatives in the Parliament, needs access to technical, economic, legal, social and organizational information at strategic, tactic and operational levels. This information must be produced by other actors with better access to information, but at the same time be managed and controlled in a way that reduces the risks of bias.

The legislative procedure, with political representatives as decision-makers, is thus positioned in the encounter between two, partially counteracting, forces: Lobbying and other activities from organized interest groups on the one side, and public elections and other democratic procedures on the other. Both of these can be enhanced by mass media coverage.

Participation in governmental inquiries and consultations give *well-organized interest groups*, and the *administration at state and municipal levels*, increased access to communicate different types of information. These forms of organized influence can represent homogeneous and delimited parts of society, with common and strong interests in a legislative issue, which means that they can overcome the difficulties of organizing collective action (Olson 1965 pp. 33–36). They can thereby act more forcefully and capture greater attention from the Government. Resources can be invested in specific investigations and surveys that are disseminated through information campaigns, meetings or in mass media.

Assuming that politicians do not have complete information on the legislative issues, there is an obvious value in this. In addition to pure factual analyzes, interest groups activities also

convey important information about which groups are positively affected and which are negatively affected of a proposal. The organizations' efforts also give a signal about the intensity of these consequences:

“Interest groups are often relatively well informed about issues that are relevant to them, and policymakers have an interest in acquiring this information.” (van Winden 1999 p. 15)

From this perspective, lobbying can be seen as a method of allocating certain information costs to where they are lowest. The risk of the interest groups acting strategically with the information is of course always present. The organizations mainly represent their own members, which is why a bias can arise (cf. Moberg 1994 pp. 145–147). The interest groups can thus fulfill an efficiency-enhancing function by providing the political decision-makers with important information regarding consequences and preferences. Since they only represent limited minorities of society, there is always the risk that the resourceful interests will be overrepresented in the final legislative decision.

A counterweight for the protection of the unorganized public is found in the general elections, where it is the number of votes that is counted instead of the intensity of the preferences. Namely, the *general elections and certain other political procedures* convey certain information about the opinions, values and preferences that are too vague and fragmented to be captured during the investigative steps or through organized lobbying. Naturally, it is not commonplace that an individual legislative issue makes any difference when citizens express their preferences in general elections, especially not in Parliamentary elections. Through the Swedish party system, voters are instead faced with cohesive programs that include social, labor market, business and environmental policies, etc. The signal that may be present in an individual reform proposal may drown in the noise from other party political issues on the programs.<sup>6</sup>

Here, however, the mass media plays an important role through the “politicization” of the issues that often takes place in the press, radio, TV and internet sites (SOU 1990: 44 pp. 57–71). The media coverage of institutional reforms that are formulated and decided by political representatives tends to become self-reinforcing once one opinion is set against another. The reason may be the great impact of mass media as an instrument of political control (cf. Lundquist 1992 pp. 224–226). The expression that a debate has become “politically inflamed” is often declared in a negative sense. What is then overlooked is the information about the voters' views and preferences that politicization entails. An individual issue can suddenly become of great importance to the marginal voters.

Other procedures for compiling similar information about the views of the electorate are name lists, petitions, etc., as well as interviews and surveys of voter sympathies. A less

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<sup>6</sup> In the local elections, however, there are single-issue parties that have been formed with only one or a few land use issues as a basis, e.g. “Stop Western route” in Ekerö municipality, “Municipal street cost party” in Tyresö municipality, “No to Tullinge airport” in Botkyrka municipality, “The Democrats” who tried to stop the Western link in Gothenburg, just to mention a few.

frequently used method is the referendum, which in recent times still has been undertaken at the municipal level. These manifestations send political signals to the elected representatives. The standpoint in an individual legislative proposal can generate political support but also become a burden.

In cases where these powers are allowed to influence the decision at the expense of a minority's more intense preferences, another type of efficiency distortion in the legislation arises. The risk that a political majority can exploit a minority is noticeable in the legal minority protections that e.g. is evident in the proportional representation system, rules of qualified majority in certain votings, etc.

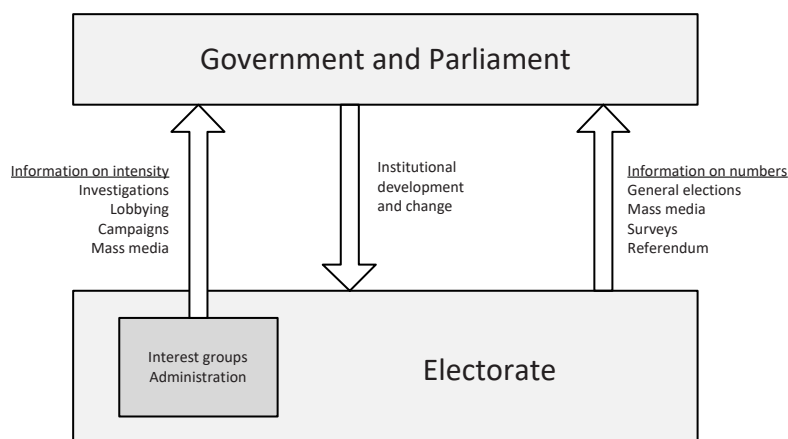


Figure 2: *The two influence flows that improves and restricts the legislator's information access.*

When these two, partly counteracting, information flows and control mechanisms described above meet with the political representatives, the importance of the legislators' own motivation and ideological perception weakens (see Figure 2 for a graphic illustration). Since the politicians do not have complete information, they become more dependent and guided by the information conveyed through lobbying and voter sympathies, rather than their own lack of knowledge over the issue.

When the flow of information from general elections, mass media coverage, etc. balances the organized participation in the legislative process, we get efficient institutions. When the information from the democratic majority (general elections) or organized minorities (interest groups and administration) is overrepresented in the legislative decision, we instead get inefficient institutions.<sup>7</sup> The information deficiencies reinforce the dependence to a certain institutional development path. All legal reforms become more or less well-founded

<sup>7</sup> The terms used by Komesar (1994 pp. 53–89) for these inefficiencies are “majoritarian bias” and “minoritarian bias”.

experimental processes, in discrete and marginal steps with a certain delay rather than in a continuous and perfect dynamic (cf. van der Krabben 1995 pp. 79–81).

#### 4. Some empirical support for the theoretical models

In this section, my intention is briefly to note some concrete indications from the documented public processes during the preparation of legal reforms in the field of land development. The endeavor is to investigate whether such manifestations can be incorporated into the above theoretical models.

##### 4.1 Findings in favor of the allocative paradigms

In the introductory section of this article, the legislator's stated pursuit of efficiency in the design of the review procedures have been exemplified.<sup>8</sup> The concept of efficiency has both procedural and material dimensions for the legislator. In procedural terms, swift, simple and cost-effective procedures are desired. The material side appears in the form of legal security and legitimacy aspects, e.g. through a broader democratic influence in the processes. At a broader level, we may also note that efficiency is a dominant objective in general administrative and procedural law statements. Overall, the objective of the entire public sector is permeated by the pursuit of procedurally and materially efficient procedures (cf. Premfors 1984, Proposition 1997/98:136).

Explicit declarations and program statements in the name of efficiency create a contractual relation to the electorate and a succeeding political accountability when evaluating the effects of reforms. The publicly presented motives become undertakings by the political representatives, and turn into rewarding targets for political debate and mass media scrutiny. The statements in preparatory works strengthen governance, control and feedback in the political accountability system.

An argument in favor of efficiency, which is often acknowledged in the context of legal reforms, concerns the need to establish a system structure and clarity in the existing regulation for a certain domain. This highlights the temporal dimension that exists in the legislation. Different development paths, established in an earlier context, gradually cross each other in a pattern that is difficult to understand. Institutional generations cling to each other far back in time due to lock-in effects. Finally, the resulting costs are large enough to overcome the barriers of inertia and stability.

At the same time, of course, the reverse is true. The legal reforms are “children of their time”, or rather creations of their institutional context. They are molded and curbed by existing formal and informal restrictions. For instance, the legal tradition in a particular domain is often cited as an argument for the specific design of a procedure. The utilization of existing

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<sup>8</sup> The findings in favour of the allocative paradigms presented in this subsection are, to a large degree, based on Ekback (2000 pp. 9–12).



organizations or competences is also an expression of the path dependence connected to institutional development and change.

The above interpretations of statements in preparatory works are broadly in line with the contract-inspired model, where the electorate conveys information and evaluates the effects through the political accountability system.

#### 4.2 Findings in favor of the redistributive paradigms

What manifestations can then be found in support of the exploitation-inspired models in the documented legislative process? A quick reading of the consultation opinions and responses from the referrals proves that organizations and authorities make good use of the opportunities the referral procedure offers. In the light of what I mentioned above about efficiency as an overarching public objective, it is perhaps not surprising that precisely such arguments from consultation bodies are sometimes presented by different organizations in support of directly opposite positions.

Whether the efficiency arguments merely act as a cover for more organization-specific motives, or is a symptom of the information deficiencies will not be elaborated here. One can nevertheless note that efficiency arguments by the consultation bodies seem to be perceived as an effective strategy to find the legislator's ears. At the same time, the costs of information and impact for those bodies that *de facto* advocate efficient solutions should be lower than for those who, in the name of efficiency, advocate something else.

Although no systematic inventory has been carried out, the trend is still striking and I am prepared to assert the following thesis: In principle, it never happens that an interest group, organization or authority responds to a consultation referral in a way that is contrary to its own self-regarding interests. Even the summary compilations in the Government's bills of the consultation responses clearly paint a picture of struggle, territorial disputes and bureaucratic imperialism.

In the following, two case studies are presented regarding opinions and positions documented in public preparatory works for institutional reforms in the land development domain. The first development path concerns the assessment of water and environmental law permit issues. The second track concerns the institutional choice between cadastral procedure and court proceedings for assessing and adjudicating issues of compulsory land acquisition and compensation.

The assessment and permit procedure according to water and environmental law

Sweden adopted its first legislation on environmental protection in 1969. During the preparatory work on the Environmental Protection Act, the commission of inquiry presented a proposal with the existing Water Courts as review authorities also in the assessment and permit procedure for environmentally hazardous activities (SOU 1966:65). Against this proposal, however, was an investigation by the Swedish Environmental Protection Agency, which advocated a central administrative permit assessment of both

environmental hazardous and water activities at the Swedish Environmental Protection Agency (Proposition 1969:28 pp. 58–59).

The existing water court organization approved the proposal to make the Water Courts reviewing authorities. On the other hand, the Swedish Environmental Protection Agency's proposal was criticized sturdily.<sup>9</sup> The Water Court of Appeal was one of the few consultation bodies that completely rejected the idea of assigning the assessment to an administrative authority, but extensive criticism also came from judiciary interest organizations such as the Swedish Bar Association and the Association of Swedish District Chiefs and City Judges. As arguments for the court alternative, the importance of rule of law and legal security were referred to.

In an overall reading of the consultation opinions and responses during this reform, one cannot avoid the impression of a tug-of-war between the Swedish Environmental Protection Agency and the Water Courts over where the permit assessment for environmentally hazardous activities should be located. The final solution turned out to be forming of a new administrative agency, completely independent of both the Swedish Environmental Protection Agency and the Water Courts – the Concession Board for Environmental Protection. Possibly, this administrative review in a court-like tribunal was the result of a diplomatic compromise.

The previous territorial dispute was revived during the work on substituting the old Water Act from 1918 with a new and modern Water Act, which was promulgated in 1983. The commission of inquiry had proposed a new review system for water activities in an administrative process (SOU 1977:27). The existing trial in the Water Courts was to be replaced by administrative review in the Concession Board for Environmental Protection, and in the County Administrative Boards.

The proposal triggered strong criticism from several courts. The court organization advocated the maintenance of the previous system, claiming that:

“... the organizational reform cannot be expected to meet the need for an efficient, swift and flexible and, from a legal security point of view, reassuring procedure [author's translation].” (Proposition 1981/82:130 p. 69)

The Environmental Code came to replace both the Environmental Protection Act and the Water Act in 1999, and the fight for the power to review entered a new phase. The commission of inquiry recommended that new regional Environmental Courts should be set up as review authorities for assessment and permit examination for both environmentally hazardous activities and water activities (SOU 1996:103).

The proposal was rejected by several consultation bodies (Proposition 1997/98:45 pp. 456–459). The Concession Board for Environmental Protection proposed that both the Water

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<sup>9</sup> As a parenthesis, it can be mentioned that the Swedish Farmers' Association expressed doubts about the need for new legislation on environmental protection at all (Proposition 1969:28 p. 64).

Courts and the Concession Board should be retained pending a more in-depth analysis. A recommendation was also put forth that the Concession Board would be transformed into an Environmental Court through a simple change of name, and that a central assessment and examination would continue to take place in accordance with the previous order.

The Administrative Courts deemed that, as a first alternative, consideration should be given to assigning the review within the framework of the existing court system instead of setting up new special courts. Both the Administrative Court of Appeal and the Administrative Court in Stockholm County considered that the environmental reviews should lie with the general administrative court system. The General Court of Appeal, on the other hand, recommended the proposed alternative with Environmental Courts incorporated into the general court system.

A number of County Administrative Boards considered that the proposal for an extension of the County Administrative Boards' permit review in firmer organizational forms:

“... is excellent, but that the areas of activity of the review authorities should be extended to include all permit reviews in the first instance of environmentally hazardous activities as well as all appeals against municipal decisions... [author's translation]” (Proposition 1997/98:45 p. 470)

Among other comments on the commission of inquiry's proposal, it can be noticed that the Government's admissibility review for certain extensive infrastructure projects was questioned by e.g. The Faculty of Law at Uppsala University and the Swedish Bar Association. These bodies considered that:

“... The permit review should not take place in a political instance but in an Environmental Court, with the possibility for the court to submit the case to the Government for review if needed. [author's translation]” (Proposition 1997/98:45 p. 433)

The above depicted story of “bureaucratic imperialism” by the concerned authorities and “rent seeking” by other concerned parties could – and undoubtedly will – be continued far into the future. Two final observations will have to end the case.

Wind power expansion is an important part of the energy transition and became a hot issue in Sweden in the early 2000's. In order to simplify and shorten the review process, a proposal for procedural relaxations ignited a tug-of-war again between the municipalities' right of review through detailed land use plans and building permits under the Planning and Building Act vs. the Environmental Courts' right of review under the Environmental Code (Proposition 2008/09:146).

Short afterwards, another proposal for procedural reforms in the Environmental Code was presented (SOU 2005:59). The commission of inquiry recommended that permit review under the Environmental Code for water activities and all types of environmentally hazardous activities should be assigned to an administrative authority as the first instance, instead of the existing system of Environmental Courts. The battle between the administrative authorities' organizations and the court-judiciary bodies became fierce once again. In the end, the court-side resigned with the victory, and the prevailing order remained (Proposition 2009/10:215).

The institutional choice between cadastral and court procedure

The second development track concerns the institutional competition between cadastral procedure and court proceedings for assessment and adjudication in issues regarding compulsory land acquisition and compensation.

In several land acquisition situations, the cadastral procedure is the sole designated process, e.g. for power line purposes, for joint facilities, or for land allocation according to mining concessions.<sup>10</sup> In other cases, court proceedings are the applicable forum, e.g. upon completion of an expropriation permit, property rights acquisition for certain water activities, compensation for public roads intrusions, or compensation for restrictions following the protection of historical buildings.<sup>11</sup> A third variant includes the situations where there is a legal scope to, alternatively, assess and determine the land acquisition and compensation issues in both procedures. The legislation thus opens up an option for the parties to decide for themselves whether the cadastral procedure or court proceedings are to be applied. These parallel potentials are applicable for municipal land acquisition of public spaces in detailed land use plans and for land acquisition for railway purposes, according to an established railroad plan.<sup>12</sup>

Historically there was a clearer demarcation between the domains of application for the cadastral and court procedures. The cadastral procedure was previously employed mainly for enclosures and other property formation measures, soil drainage collaborations and in mining law. In pure land acquisition situations, the court procedure was traditionally designated. Following the adoption of the Real Property Formation Act in 1970, there has been an increase in the legal domain of application for cadastral land acquisition procedures.

We may therefore begin with some views that were proclaimed during the preparatory work with the Property Formation Act. The commission of inquiry's proposal for a new cadastral procedure (SOU 1963:68) received strong approval from the National Land Survey organization and from the municipalities. However, several judiciary bodies expressed doubts and critical views. The Swedish Bar Association questioned in particular the coercive possibilities that the new institutes of property reallocation and redemption entailed, and argued that more extensive reallocation measures should be reviewed in court already as a first instance (Proposition 1969:128 pp. B42, B65 and B607). The Court of Appeal in Stockholm considered that:

“The [Property Formation] Commission has not shown that it is necessary to introduce an expropriatory procedure in the Property Formation Act in addition to the coercive measures provided by the building and expropriation legislation... [author's translation]” (Proposition 1969:128 pp. B581–582).

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<sup>10</sup> The Utility Easements Act, the Joint Facilities Act, and the Mining Act, respectively.

<sup>11</sup> The Expropriation Act, the Environmental Code, the Roads Act, and the Heritage Conservation Act, resp.

<sup>12</sup> The Planning and Building Act and the Railroad Construction Act, respectively.

The same organizations also criticized that the property owners could not receive cost reimbursement during the procedure, and thus obtain a legal representative (e.g. p. B192), an objection which was also raised by the landowners' interest organizations (p. B581). The Swedish Farmers' Association and the Swedish Association of Forest Owners also opposed that an expropriating party or other compulsory acquirer should have the right to initiate a compulsory property reallocation (pp. B342–344).

In the Utility Easements Act and the Joint Facilities Act, which were prepared shortly afterwards, the cadastral procedure was designed according to the structure in the Property Formation Act. The criticism was repeated against the fact that landowners and other right holders would not receive compensation for own investigations and legal representation costs. The objections were proclaimed by different courts, the Swedish Bar Association, the Swedish Farmers' Association and the Swedish Property Owners' Association (Proposition 1973:157 p. 63). On the other hand, the proposals were contentedly approved by the National Land Survey (see also Proposition 1973:160).

Some years later, several inquiries and draft reforms of the cadastral procedure were presented, i.a. to facilitate municipal land acquisition for the implementation of detailed land use plans (SOU 1984:72). The proposal was endorsed by the National Land Survey, however met with strong criticism in most of the consultation bodies and were not implemented.

The National Land Survey subsequently produced a modified proposal (LMV 1988) which, on the other hand, to a large extent formed the basis for the amendments in the Property Formation Act that came into force in 1993 (Proposition 1991/92:127). The National Land Survey's proposal, which was intended to facilitate and expand the cadastral institute's usefulness for plan implementation, was approved by the majority of consultation bodies. Among those who rejected the proposal, the Swedish Bar Association claimed that the proposal accentuated the expropriative function of the Cadastral Authority. The Bar Association emphasized that expropriative procedures should principally take place in court (Proposition 1991/92:127 p. 32). On the other hand, the Bar Association advocated that the parties concerned should be given a very extensive right to cost compensation (for attorneys) in these procedures, something that was also put forward by the Swedish Farmers' Association (p. 48).

The usefulness of the cadastral procedure in land acquisition situations had, however, been pointed out from land survey advocates much earlier, then in more cautious terms. When the Nature Conservation Act was prepared during the 1960's, the District Surveyor in Chief in the County of Stockholm emphasized that the compensation assessment for restrictions on land use due to nature protection could be more efficient, compared to the existing court review:

“In view of the recognized heavy and time-consuming apparatus which expropriation cases entail, it seems important to try new ways for a smoother handling of compensation issues. One possibility, which deserves closer examination, is to refer the question of compensation to a special cadastral procedure. [author's translation]” (Proposition 1964:148 p. 125)

Also during the preparatory work on the 1983 Water Act, the cadastral procedure came to stand against the court procedure regarding soil drainage projects. Stockholm District Court deemed that certain soil drainage projects could advantageously be assessed in the same order as other water projects, i.e. in Water Court (Proposition 1981/82:130 p. 76). In opposition, the National Land Survey considered that the existing Joint Facilities Act – with a cadastral procedure – could be made directly applicable to soil drainage collaborations (p. 152).

Subsequent legal reforms included preparation and adoption of the Railroad Construction Act, which for cadastral land acquisition procedures entailed a wider scope of application. The proposal was endorsed by i.a. the National Land Survey at the same time as the Bar Association, the Swedish Farmers' Association, and other landowners' organizations rejected the proposed amendments (Proposition 1995/96:2 pp. 43–44).

A few years later, with the adoption of the Environmental Code, the outcome was the opposite. The previous cadastral procedure for soil drainage collaborations was eliminated, and the new proposed review procedure in the County Administrative Board and the Environmental Court of soil drainage was rejected by the National Land Survey, which considered that the cadastral procedure should continue (Proposition 1997/98:45 p. 474). The National Land Survey also proposed that the cadastral procedures should be assigned to the regular Cadastral Authority, whereby the regulations on soil drainage could be incorporated in the Joint Facilities Act.

Thus, time has come to end this limited survey of observations in support of the redistributive theories and models. The struggle between interest groups and authorities has left clear traces in the public documentation of the legislative process. Admittedly, much more can and should be said on the issue, but for reasons of space I wish to conclude with a closing reconnection of the empirical observations to the previously presented theoretical models.

## 5. Analysis, discussion and some concluding reflections

In the previous section, two case studies were presented regarding the possibilities in the legislative process for influence and impact from authorities and interest groups, and to what extent these stakeholders actually utilize these possibilities. The reported views and comments show clearly that the organized interests are well represented in the legislative processes. The authorities in particular show a great deal of commitment regarding their own areas of activity, and territorial disputes seem to be more the rule than the exception.

With regard to the choice of review authority and review process for water activities and environmentally hazardous activities, it is easy to follow how the various authorities and their interest organizations monitor their existing areas of competence, and are eager to strive to expand these. The landowners' organizations and professional associations also make themselves heard, and try to influence the outcome in as positive a direction as possible in order to benefit their members' interests.

The case concerning the procedural choice between cadastral or court procedure for assessment and determination of land acquisition and compensation measures exhibit similar

features, where authorities protect and try to expand their own area of activity and competence. Professional associations and landowners' organizations are struggling to benefit their own members' interests regarding the labor market and reimbursement opportunities. And as a rule, all this in the name of efficiency!

As previously have been pointed out, however, there exist an opposing force and impact in the explicit statements and program declarations where efficiency is proclaimed as an objective. These statements are often presented in many legislative processes, including these case studies. These public statements in preparatory works and mass media create a contractual relationship and a political accountability that can be claimed when evaluating the effects of reforms. The objectives and arguments presented by the Government in preparatory legislative works thus strengthen the democratic governance, control and feedback in the political accountability system.

The importance of organizational and competence-based development tracks can be clearly discerned in the case studies. This is particularly evident in the first case study, where path dependence and inertia created by the older organization with Water Courts is represented.

At the same time, the transparent processes and active participation suggest that, e.g. with regard to the ongoing territorial disputes, that ineffective institutional solutions are likely to be difficult to sustain in the long term. Here we can see an analogy to the evolutionary approach to institutional change, but also explain why this may evolve in the direction of increased efficiency. No "invisible hand" controls the development, but this is determined by the stakeholders' access to and cost of producing and communicating information to the legislator. The stakeholders who advocate efficient solutions simply should be able to produce and communicate the information at a lower cost in the legislative process.

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As a final reflection, I would like to recapitulate the objective of this study and what has been accomplished. The objective of this article was to present some prevalent theories on institutional development and by some empirical studies evaluate the explanatory and predictive capacity of these theories.

As a conclusion, based on this limited legal domain of land development, it seems that both the allocative – or value-enhancing – theories as well as the redistributive theories have a noticeable explanatory value. The case studies also exhibited clear indications of path dependence. The summary observations made thus indicate that all different factors were present in the design of the review procedures in question. Focusing on the information flows in the legislative procedure, given the presumption of imperfect information, also downplayed the role and incentives of the legislator.

Whether current legislation on land development is socially efficient or inefficient remains to be answered. But the causes for this are to be found in the institutional design and restrictions in the law-making process. The basic problem is to produce relevant information and involve concerned actors. The outcome is determined in the interplay between



information access and institutional control and monitoring mechanisms. However, my discourse in this area must stand as unfinished reflections. The issue of efficiency and institutional development and change requires a much broader and deeper treatment than what has been possible here to be fully understood.

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# Cadastral Development in Norway – Long Term Implications of Policies and Organisational Choices

## Abstract

The authors' ambitions with this paper are to interpret the development of a cadastral system where land information is encumbered with inaccuracies and flaws. Being only recently developed on the European rim, the Norwegian cadastral system as a variant of the German one, gives rich opportunities to explore how its origin and evolution have consequences for the quality of the existing information. The investigations are directed at the basic surveying, mapping and registration of real property, the technological modernisation process, and the organisation of this process. The findings indicate shortcomings within all these components for developing a cadastral system.

## 1. Introduction

Errors and misregistration in the Norwegian cadastral map have been observed for many years and are still present today (Leiknes and Mjøs 2021; Leiknes et al. 2021). The quality of the existing spatial land information reflects how this nationwide system was constructed, how the historical information was registered, and how it was maintained and updated during property formation processes. Institutional characteristics of the cadastral system as such, the procedures for the initial registrations, as well as subsequent registrations up to the present day, all have consequences for the quality of information as well as the functionality of the cadastral system (Larsson 1991; Bogaerts and Zevenbergen 2001; Mjøs 2016; Mjøs 2020).

The development of cadastral systems results from intended choices. Public authorities are normally responsible for the initial initiatives that establish key institutions, as well for the initiation and implementation of subsequent reforms. The origin of the Norwegian cadastral system was the authorities' ambitions for land registration and taxation, which necessitated rules and regulations for establishing and maintaining such a system. Both establishing and further developing the system would be dependent on inputs and efforts from different actors or players in these processes. And as elsewhere, the justifications for establishing the system could be decisive for defining categories of property units and property information

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to be registered, how it was registered, and the technology used for registering and processing information for individual and public use.

In the following we start by asking, from a historical vantage point, why and how to survey, map and register land in Norway. Then we dive into the issue of modernisation to focus on choices made in relation to maintenance and further developments of the system in the more recent past. Under the third heading, we describe how these modernisations processes were organised; what was the formal purpose of these efforts and how was the work divided between actors with different competences. At the end we present a brief status of current categories of errors, misregistration and shortcomings in the cadastral

## 2. Survey, map and register land?

### 2.1 Surveying – where for mapping?

In Norway's early urban development, land plots were subject to certain measurements. In the largest urban areas, like Bergen and Oslo, cadastral surveying was introduced in the 1700s. The system for property surveying was gradually developed and reformed through urban building acts from 1827 onwards.

Regarding cadastral registration, the Norwegian countryside was regulated by other regimes than the urban areas. Rules for cadastral registration of land for the purpose of taxation were adopted in 1665. The immediate purpose of this cadastre was taxation of biologically productive land according to uniform principles. The taxation was based on a record of the holdings' production value (skyld), but without any kind of surveying or mapping (Austenå 1988). Should holdings later be subdivided, the production value had to be allocated again, as the subdivision of the holding meant that there would also be a subdivision of this value between the old and new properties (skylddeling).

Rules regarding description of property boundaries in connection with property formation were adopted in 1764. From this early period, boundary descriptions in rural areas were carried out roughly and sporadic, mainly according to owners' requirements. Dependent on the size and complexity of the relevant holdings, the measurement could be limited to a part of the property under subdivision. Rules regarding description of property boundaries in rural areas were successively reformed in the cadastral acts of 1845 and 1909. Another characteristic of the measurement and registration of land in rural areas, still present today, is the Land Consolidation Courts, which were established in 1859. These courts produced large volumes of land consolidation maps showing boundaries prior to and after the land consolidation processes, especially in the late 1800s and early 1900s. The land consolidation maps were island maps, not connected to the geodetic network, but are generally recognised as being of high quality.

It would take until the adoption of the land subdivision act of 1978, which took effect in 1980, before rules were introduced that equalised procedures for cadastral surveying in urban and rural areas, a crucial condition for the production of a coherent property map for

the whole country. The division in cadastral surveying between urban and rural areas lasted until 1980 despite reforms implemented in Denmark during the breaking up of the Denmark-Norwegian double monarchy in 1814. The division also outlasted the following union with Sweden and remained in place for almost 80 years after Norway gained independence in 1905. In reality, the respective Norwegian authorities maintained more or less the system for surveying and mapping of land that was established during the double monarchy and union periods. This system was maintained despite reforms in cadastral surveying and mapping implemented in these neighbouring countries.

## 2.2 Who benefits or should benefit from cadastral mapping?

The issue of cadastral mapping reached the national agenda immediately after the end of the double monarchy. The modernisation of the property taxation system that had started in Denmark-Norway in 1804-05 with cadastral mapping was proposed to continue, but the new Norwegian Parliament, dominated by farmers, rejected the proposal in 1815 (Mjøs and Røsnes 2021). Instead, the parliament chose to continue with the older cadastre based on property values. Formally, the justification was the high costs for implementing a mapping-based system and the weak economy of the new state. A more likely reason was the farmers' apprehension of state encroachment on their property rights. Combined with other arguments and support from other groups, the farmers' representatives were able to bury the idea of economic resource mapping for the whole country for almost 100 years and delay the actual mapping for nearly 150 years.

Economic mapping initiatives were recognised around 1900, but without sufficient justifications for the state authorities to start preparations for surveying (Paule 1997). This reluctant attitude to modernise the country's property map can be explained partly by changes in the tax system, from state property tax to state income tax, and partly by the upcoming struggle over formal competence in these matters between what was at that time the Norwegian Mapping Authority (NMA) and the Land Consolidation Authority (LCA), which had its own land court (Mjøs and Røsnes 2021).

Conflict of interests and lack of coordination in policy initiatives characterise the early phase of economic mapping. Mapping committees had elaborated possibilities for economic mapping based on aerial photogrammetry in the late 1930s (Mjøs and Røsnes 2021). A new committee operating within the same scope was appointed in 1957 and around 1960, the new economic mapping movement finally begins (Paule 1997). Inputs from the committee resulted in the establishment of the Mapping Council (MC) (Kgl. resolusjon 16. februar 1962) with its main function being to give professional support to counties and municipalities which intended to start economic mapping on their own. The MC delivered its proposal in 1963 (Samferdselsdepartementet 1964a) and the Parliament decided on the general guidelines for economic mapping in 1964.

The most important aim for the resulting mapping activities, which had at this time started in many municipalities and regions, was to produce suitable economic maps for public

planning. Unlike economic mapping in comparable countries in the 1800s (Williamson et al. 2010), the needs for reliable spatial information for taxation or property management were not highly prioritised. Special policy interests and organisational fragmentation characterise these early attempts to implement mapping programs. The country's central centre of competence in mapping and surveying, the existing NMA, which had at this point existed for almost 190 years, was not given an independent role in the committee work.

Uncertainties resulting from the fragmented process ended temporarily with new white papers on mapping policies and administration from the Ministry of Environment. This led again to new committees and reports (Kart- og oppmålingskomiteen 1975; Miljøvern-departementet 1976). With approval from Parliament, these reports and recommendations eventually became the institutional and technological basis for the mapping and surveying that would take place later and that would serve as the foundation for the current cadastral system (Kartplanutvalget established acc. Kgl. resolusjon 21. januar 1977).

### 2.3 What should be registered – cadastral units or properties?

The dawn of European cadastral mapping ascended the late 1700s motivated by philosophers and their understanding of property rights as one of the human rights (Scott 1998 and Linklater 2013). Cadastral map information in territories under German and Austrian rule was coordinated with the Grundbuch in which the surveyed parcels would define the property rights towards other parcels belonging to other owners. Such cadastral maps are parcel based (Zabala 2017). They constitute the very geometric basis for land administration systems in these countries (Enemark 2005). Obligatory registration in the Grundbuch of legal documents that prove ownership to these parcels was introduced in different ways, but require surveying and registering in the cadastral map, which then will define the spatial extension of the property.

When the Norwegian authorities, during the revision of the tax cadastre in 1818–1836, implemented in 1838, tried to modernise the cadastre, they chose another variant than modernisation with cadastral mapping (Mjøs 2016). Each property was enumerated and given a specific property number. Following the subsequent coordination with the Land Book the property with this specific number became the defined unit of land in the Land Book linked with the new cadastre. In consequence the Norwegian cadastre today is *property based*, not parcel based. Still, it is classified as a cadastre of German type, in which the property boundaries of the parcel constitute the unit in the cadastral map (Leiknes and Mjøs 2021).

Challenges in the management of property-based cadastrals are particularly related to changes in property rights, spatial delimitations of such rights, but also to institutional changes in the cadastral definition of the types of real estate that may be registered. However, the very basic characteristic of the old cadastre remains in place despite later reforms to improve the reliability of property information, to overcome existing failures and misinformation, and to unify the system for surveying and property formation in urban and rural areas. How to

improve reliability of property information within the system is still an ongoing discussion. Observed uncertainties and failures are partly dealt with by new rules about property formation, but the content of the cadastre also reflects a history of various local and ad hoc procedures. Moreover, while the 1978 Act unified parts of the system from then on, the landowners' freedom of contract regarding their boundaries remains in place, so that boundary changes may not be formalised through a public cadastral survey at all.

### 3. Technological modernisation

#### 3.1 Policies and agents

Cadastral information became generally less important because of a transition from property tax to income tax in late 1800s. The Land Book gained greater importance. Descriptions of boundaries and property rights could be found here. But a coherent economic map with cadastral information suitable for planning and land management was still lacking, a challenge that became particularly demanding during the reconstructions after WW2.

When the Norwegian Parliament in 1964 adopted the guidelines for economic map production, ideas for new mapping technologies and more advanced production of geo-referenced data made their entrance (Samferdselsdepartementet 1964a). New tools for mapping together with new possibilities for digital mapping soon arrived. There were also significant opportunities for compilation of spatial data from existing mapping sources, albeit of varying quality. Data from other registries would also be attached to the system for property identification (Geodatakomiteen 1971). The resulting rules and regulations for cadastral surveying should define conditions for producing reliable and valid spatial data (Miljøverndepartementet 1978).

The steering group for the production of property information based on this technology, appointed by the Ministry of Environment, assumed that the municipalities would, out of self-interest, establish registries for ground property (G), addresses (A) and buildings (B) linked to a new property register (SUG 1975, cf., McLaughlin 1975). However, nothing was discussed about how failures and mistakes in the existing boundary information could be addressed; how obligatory registration of title would be necessary to secure registration of property formation agreements in a country with freedom of contract; nor how informal succession of ownership to property rights might complicate the identification of responsible property owners (SUG 1975).

Digitalisation of boundaries in the economic maps started during the 1980s, to produce digital property maps for the largest municipalities based on their own registering of spatial details of individual properties and municipal maps. Governmental County Mapping Offices then digitized the economic maps mainly for medium and small municipalities. This "mixed" operational structure called for coordination and ended with cooperation between the NMA and the Central Association of Municipalities. In 1991 they established a joint model for cooperation in data production and exchange to produce a coherent digital property map – DEK ([D]igitalt[E]igedom[s][K]art).



After a relatively short time it became clear that the Land Subdivision Act of 1978 (LOV-1978-06-23-70) did not fulfil its goals. A new act, named the Cadastre Act was adopted in 2005, to also facilitate the establishment of a new cadastre (Matrikkelen). Extended needs for reliable property information in public planning was underlined, (Matrikkellovkomiteen 1999). However, the reform took place without coordinated changes in the procedures for surveying and updating of spatial property information encumbered with errors and omissions, so much of what is currently found in the cadastre reproduces historical problems.

### 3.2 Aerial mapping and boundary demarcations

Property mapping through aerial photogrammetry during the 1960s required signalling of property boundaries in the terrain to transfer the boundaries to the map. Before photography took place, the landowners in question should themselves put up the signals but organised and advised by the LCA. Boundaries should only be signalled and transferred to the new cadastral map for those properties when the costs in relation to benefits could be justified (Samferdselsdepartementet, 1964a, 1964b). The MC strongly opposed this pragmatic, unprofessional procedure, which probably would transfer failures and flaws in the existing property information, in many cases without input from existing owners about their ownership's spatial extension.

Another challenge was the reliability of the ownership in the GAB-registry ([G]runneien-dom, [A]dresses and [B]buildings) and the spatial quality of this information. Additionally, the cadastral units in the Land Book had been changing since 1980 as new units had been established according to the Property Registration Act, Sec. 5 (LOV-2005-06-17-101). The responsibilities for updating and delivering this information were shared between the decentralised mapping authority offices and municipalities (Mjøs and Røsnes 2021).

### 3.3 Cadastral surveying

Earlier legislation had imposed procedures for cadastral registration in urban settlements. But in contrast to these earlier rules that typically required surveying when a property was sold, the legislation from 1978 dropped such requirements (Larsen 1978). The Land Consolidation Court could practice surveying of properties in rural areas on demand, if the property owners requested it. However, these cases could scarcely contribute to systematic improvements of land information needed for a coherent cadastral map (Mjøs and Røsnes 2021).

The development of the cadastral system and cadastral surveying more specifically indicate that both landowners and others who need cadastral information from the property map will have to struggle with inaccuracies and faults in the cadastral map, cf. below. Cadastral reforms have been aiming to eliminate this problem, but so far with limited success. As a result of low-quality information, disputes can arise that have to be resolved in the courts. Compared to neighbouring countries the amount of property related lawsuits in Norway is very high and the trend over recent year seems to be rising (Mjøs and Røsnes 2021).

## 4. Organisation of modernisation processes

### 4.1 Purposes, contradictions, and priorities

Aerial photogrammetry contributed to reduced costs of map production. And in the same period new tools for collecting, storing, and processing of geographic information opened for new uses and financial perspectives on the data economy (Paule 1997). Committees and groups were appointed to elaborate and propose strategies and procedures for modernising the mapping and surveying systems. The new technology raised discussions about how to identify data producers and data owners as well as who should pay for the production and whether one should require payment for delivering data. During the 1980s, the authorities focused more clearly on the demand for spatial data and the government underlined that public data production should to a large extent be financed through market mechanisms (Paule 1997). Producers and managing units of this information became more concerned with the financial aspect of the information they actually controlled or possibly could control in the future.

Such developments continued in the 1990s. Several state entities and municipalities agreed then to cooperate on the production and up-dating of geographic information on a new organisational platform, *Geovekst*. Later, the public authorities joined under a common umbrella coordinated by the NMA. The financing was partially based on benefits for participants (Paule 2007). The Ministry of Environment established in 1997 *Arealis*, a so-called participant led cooperation between municipalities, counties, and state entities to rationalise the access to georeferenced information on land, land use plans, environment and land-based resources. Through these two organisational entities, different procedures for production and processing of data for property mapping occurred, partly inside what existed from before, partly outside. In 2003, a new white paper addressed needs for commitment to agreements and leadership, and a new organisation, *Norge digitalt*, was established to, among other things, secure easier access to geodata and thematic geographic information (Miljøverndepartementet 2003).

Symptomatically, the struggle concerning control over GAB-data sharpened when the use of electronic technologies gained ground. Discussions over access to this data pool was raised both between municipalities, and between municipalities and the NMA, which eventually had been empowered with authority over these data categories, including the recently established DEK (Tørstad 1996). When the new Cadastre Act was adopted in 2005 it defined the cadastral map under state authority although with divided responsibilities. The municipalities should still be responsible for the operative provision of surveying data to this map.

The cooperation under *Norge digitalt* was based on negotiations and agreements regarding financing of data production and sales. Later the leadership had to take a stand towards EU's directive 2007/2/EC, INSPIRE, on payment for having access to cadastral information. The ambition was to improve access to geodata as an essential basis for policies and management

of the environment. The Norwegian parliament adopted then the Geodata Act which introduced free access to data necessary for critical functions and value production in the society (LOV-2010-09-03-56).

#### 4.2 Sharing of responsibilities and tasks

The economic mapping project started with a divided organisation of responsibilities. The administrative organisation could vary between the counties, but the NMA should coordinate dissimilar approaches and control the procedures for approval of all the separate plans for mapping. As early as in 1974, the Ministry of Environment underlined dissatisfactions with the organisation and related procedures (Paule 1997). This resulted in a new whitepaper focusing on the future organisation, cadastral mapping procedures, outcomes and management of cadastral data (Miljøverndepartementet, 1976). The organisation at central state policy levels in this period was also dominated by ad-hoc committees (Paule 1997). All county mapping offices were transferred to the State in 1986, becoming NMA's regional mapping offices. When the mapping work ended in 2002, new kinds of organisational constructs had been established in the meantime (Mjøs and Røsnes 2021). Presently 10 regional offices with mapping responsibilities exist, still operating with different organisational models.<sup>1</sup>

The overall technical standard for this mapping, SOSI, was developed during the 1980s and 1990s. The NMA declares that in principle everybody can participate and influence the content of the standard. With a different composition of members, 9 working groups have been responsible for this work. Norge digitalt is described as a broad cooperating organisation consisting of 600 parties. A national arena for meeting is the National Geodata Council that consists of 16 members together with representatives from five other independent professional mapping and cadastral entities.<sup>2</sup> Geovekst works in parallel with Norge digitalt under a common secretariat with 21 members.

The fragmentation and overlapping that characterise the assignment of authority, responsibility and duties can in many ways also be found in the fragmented legislation related to property formation, land registration and land information. The governmental authority for updating and reforming this legislation is scattered between several ministries. Legal reforms have been introduced partially without directly coordinated perspectives on property formation and registration in relation to mapping and cadastral management.

#### 4.3 Competence vs. organisation

In the early cadastral development for taxations, laymen oversaw property surveying and registering in the rural areas, with rough boundary descriptions. In the urban areas, the first property surveyors were, from the early 19<sup>th</sup> century, state officials subject to formalised

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<sup>1</sup> <https://www.kartverket.no/om-kartverket> (2023-02-14).

<sup>2</sup> <https://www.geonorge.no/Geodataarbeid/Norge-digitalt/forumer-og-arbeidsgrupper/>(2020-05-01).

competence requirements in surveying and property management (Engelstad 1981). However, the competence requirements were removed from the legislation in the latter 1800s. What competence was to be required became the responsibility and privileged decision of the individual urban municipality.

The issue of professional competence was closely related to the local organisation of these services. In the urban areas the municipal officers were responsible for cadastral surveying, while in the countryside the laymen were appointed locally. The Subdivision Act did not have specific requirements for competence. Cadastral surveying came then under the responsibility of a municipal monopoly, instead of a national state agency (Skylddelingsutvalget 1973). This system for deciding over competence and organisations proceeded with the current Cadastre Act.

When the Ministry of Environment considered the needs for revision of the Property Subdivision Act in 1996, the lack of professional cadastral competence and the challenge of recruiting this competence in the municipalities were two of several justifications for a future revision (Matrikkelovkomiteen 1999). The legislative committee proposed that the municipal cadastral surveyor should be replaced by private surveyors based on authorisation and licencing.

During the hearing for the proposed new legislation, labour organisations for surveyors strongly opposed the proposal for the development of a privatised surveying profession with an authorisation requirement (Onsrud 2013). When the new government came into power, it gave support to those objecting and the proposal for a new act on property registration was adopted without the previous requirements for competence, authorisation and a licence (Miljøverndepartementet 2007).

Later, when the Parliament in 2016 asked the government to consider how cadastral surveying and registration should be organised, the competence issue once again came to the surface. After discussions forth and back, where opposing interests gave their inputs, a compromise based on requiring a «surveying letter» as a proof of competence for municipal surveyors became a possible solution. By a Parliament decision in 2018, a new authorisation requirement for the municipal cadastral surveyors was decided (Kommunal- og moderniseringsdepartementet 2019). Initially, the authorisation system was to be introduced from 2024. The introduction is now postponed to 2026. The Mapping Authority has started to examine applicants, and 393 surveyors have by February 2023 passed the authorisation examination.

## 5. Examples of prevailing failures and inaccuracies in the cadastral map

### 5.1 Missing properties and single-point registrations

The quality of the cadastral map is varying. An example is properties not registered in the cadastral map, or properties mapped with one or more single points that are not necessarily boundary points with boundary lines between them. Properties mapped as single-point pro-

properties are marked in the map with fictitious boundaries, shown as a hexagon or octagon. Even if some of the land leases actually are single-point leisure properties with no fixed boundaries in the field, most of the single-point properties are incorrectly mapped properties. The cadastral map will consequently in an incorrect way show the area of the single-point property as a part of a neighbouring property, normally the property which the single-property is subdivided from (the “mother-property”). The example in an area close to Bergen in Figure 1 below shows the occurrence of single-point properties in the cadastral map.

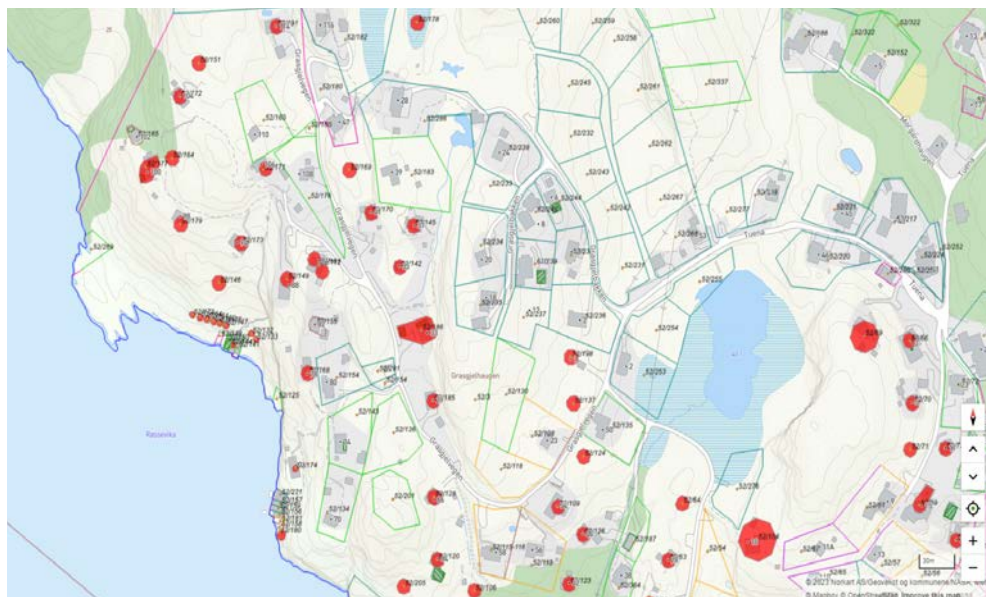


Figure 1: Single-point properties in an area nearby Bergen.  
(Source: <https://kommunekart.com/>)

And Table 1 contains statistics for properties in Norway not shown in the cadastral map, and properties shown as single-point properties.

Table 1: Property units and leaseholds in the cadaster 2020. (Source: Norway mapping/ Leiknes and Mjøs, 2021 p. 146)

Cadastral unit type	Number of units	Cadastral units not registered in the cadastral map		Cadastral units registered as single point property and fictitious boundaries	
		Number	Per Cent	Number	Per Cent
Ground property	2 584 668	65 931	2,5	84 139	3,3
Land lease	153 311	14 415	9,4	29 530	19,3



## 5.2 Property boundaries not correctly registered in the cadastral map

There are numerous boundaries incorrectly registered in the cadastral map. There are no available statistics for this, but indications are that maybe as many as 50% of the boundaries should be considered as “incorrect”. The causes for this are many. The boundaries might be incorrectly mapped in the economic mapping and consequently may be incorrect when digitised, or errors may have occurred during the digitizing process.



*Figure 2: Boundary mapping for the area Grimsoy in Røst Municipality, County of Nordland. Map to the left showing boundaries in 2020. Corrections carried out in 2021 during field exercises at Western Norway University of Applied Sciences are shown in the map in middle. In the economic map to the right are shown boundaries produced using analogue methods from the 1984 imagery. The figure illustrates the lack of quality control in the digitizing process.*

It seems obvious that the situation in Figure 2 is caused by lack of quality control in the transformation from analogue map (economic map) to the present digital cadastral map.

## 5.3 Other categories

The coastline, and waterways and lakes, represents a special challenge in the cadastre. Ownership extends into the seabed, to where the seabed starts to fall steep (no: marbakke), or to 2 meters depth or where there is no “marbakke”. Waterways and lakes are in private ownership. Boundaries towards the sea and in waterways and lakes are in general not determined by cadastral surveys, and normally boundary lines are imported from economic or topographic maps (produced by photogrammetry) and registered as “approximate boundaries”. Another challenge is boundaries following public roads. These boundaries are often boundaries automatically generated from the centerline of the road and registered as “approximate boundaries”.

Finally, we have land parcels with no property identification, or erroneous property identification. According to statistics from 2017, 15% of the land area of Norway is lacking the basic information of property identification (Leiknes and Mjøs 2021). This is generally waterways and lakes, and outfields and mountainous areas, but can also be the situation in built-up areas.

#### 5.4 The boundary disputes

A special characteristic of the Norwegian cadastral system is the high and increasing frequency of land disputes. When a new cadastral act was adopted in 1978, an expected effect was that the number of disputes would be reduced. While there were less than 10 boundary disputes brought to court in Denmark annually, the number of disputes brought to the land consolidation courts in Norway in 2007 was approximately 1000, and the number is increasing. Inadequate legislation, lack of binding educational requirements for cadastral surveyors, lack of formal obligations to perform investigations when boundaries are surveyed, and the lack of mandatory registration of boundary changes, are leading to a poor boundary determination system and poor quality in the cadastral map, and potential boundary disputes (Mjøs 2020).

## 6. Ending words

In this paper we have interpreted the development of a cadastral system where data and other information are encumbered with inaccuracies and flaws. The aim has been to reveal factors that over time can explain the origin and evolution of such failures, and why they still exist. To conclude, choices and strategies related to cadastral surveying and mapping, together with technological modernisation and organising of such processes, are both important to understand the origin and content of property registries and the reliability of property information. For the Norwegian cadastral map and the information found in it, the impact of special interests, as well as professional groups and their agents, can explain the backwardness over time. In addition, the fragmented and contradictory organisation of attempts to modernise this system and improve the competence among cadastral professionals, seems like an important contributing cause of the current situation.

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# A Reflection on the Sustainability of Urbanization in Europe since 2000

Evidence from the ESPON SUPER project

## Abstract

As a push towards sustainability, the European Union has set a goal of achieving ‘no net land take by 2050’ (NNLT) – essentially calling for a halt to urban development. Thanks to relatively detailed land cover data for the 2000–2018 period, we can evaluate the progress towards this goal as well as question whether this is a suitable metric for sustainable land use. In purely quantitative terms, NNLT is far from being achieved. Focussing on urbanization alone is however insufficient. As the vast literature on sprawl has demonstrated, it is not only the amount of land being developed which matters for sustainability, but also its form. To evaluate this, NUTS-3 regions in Europe were classified in terms of their urban (sub)structure and the changes to this (sub)structure in the 2000–2018 period. The results reveal that the most common structure is ‘polycentric’ and that most countries possess both compact and more diffuse structures. Worryingly, some countries are becoming increasingly diffuse, particularly Poland. We argue that both aspects should be taken together when considering the sustainability of urban development, even though the latter is not on the European policy agenda.

## 1. Stopping land take and urban sprawl

In June 2023, the European Commission is expected to publish a proposal for a Soil Health Law containing an objective to achieve ‘no net land take in 2050’ (NNLT), essentially mandating that urbanization be brought to a halt (European Commission et al. 2016). For rapidly growing countries like the Netherlands, this target has come at an inconvenient time: a newly appointed minister for Housing and Planning recently pledged to build close to a million new homes as quickly as possible. Until now, it was assumed that many of these would be realized on the greenfield sites on the urban fringe where developers had been amassing land (Ten Cate 2022). The realization that the European Union could stymie these plans has produced disbelief and consternation in the Netherlands and elsewhere (Build Europe 2022). At the same time, this target is over a decade old.

A reason why NNLT has come as such a surprise is that its origins lie outside the domain of planning, which is not formally a competence of the European Union (Faludi and Waterhout 2002). For planners, ‘land take’ conjures up other images than urbanization – in the United States and elsewhere ‘takings’ is given to mean eminent domain or downzoning

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\* Netherlands Environmental Assessment Agency (PBL).

(Alterman 2010) – but in environmental sciences and policy it is a common term referring to the destruction of high-quality topsoil by sealing/construction. The first EU policy appearance of NNLT was in a document on natural resource efficiency (European Commission 2011). Soil protection has since gained ground by its 2014 inclusion in the revised EIA directive (Schatz et al. 2021) and by its 2020 inclusion in the European Green Deal taxonomy.<sup>1</sup> The codification of NNLT in the upcoming Soil Health Law is therefore a logical and significant step in an ongoing policy process. According to the most prominent definition, NNLT takes an absolute stance: every hectare of land ‘taken’ from agricultural or natural areas for urban use is deemed unsustainable.

The European Commission has so far been reluctant to link this goal of arresting urbanization (NNLT) to curbing urban sprawl. This is understandable from a legal perspective, but this choice has the disadvantage of excluding urban form from the discussion. Sprawling urban development produces more land take per capita and carries additional disadvantages for sustainability such as car dependency, landscape fragmentation and reduced energy efficiency (EEA and FOEN 2016). Moreover, it misses the opportunity of engaging the same European spatial planners who are ultimately needed for the implementation of NNLT.

The fact that both aspects of urbanization – quantitative (land take) and qualitative (sprawl) – are important for sustainability was acknowledged by the ESPON programme in a 2019 call for tender: “the service shall provide evidence, recommendations and measures on how sustainable land use can be promoted and how *land-take* and *urban sprawl* can be avoided, reduced and compensated in Europe, its cities and regions” (my emphasis). The contracted party operating under the name Sustainable Urbanization and land-use Practices in European Regions (SUPER), went a step further by rejecting both terms in favour of the more neutral ‘urbanization’ and ‘urban form’. The remainder of this chapter builds on the findings of this project and subsequent work by its authors.

## 2. Urban growth in European regions

Only with the production of uniform and periodically updated pan-European data on land cover has it been feasible to consider a European target on land take. The Corine Land Cover (CLC) and Corine Change (CHA) datasets contain information on the European Union as well as Turkey, Iceland, and the Balkans. The monitoring extends back to 1990, but the most reliable period for comparison is 2000–2018. Even though higher resolution datasets exist (e.g. GSF, GUF, GHSL), Corine remains the industry standard – and the preference

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<sup>1</sup> Under the activity ‘construction of new buildings’ it is stipulated that the “new construction is not built on one of the following: arable land and crop land with a moderate to high level of soil fertility and below ground biodiversity as referred to in the EU LUCAS survey (609); greenfield land of recognised high biodiversity value and land that serves as habitat of endangered species (flora and fauna) listed on the European Red List (610) or the IUCN Red List (611); land matching the definition of forest as set out in national law used in the national greenhouse gas inventory, or where not available, is in accordance with the FAO definition of forest (612)” (European Commission 2020).

among European institutions – for monitoring European land take because it offers a high number of land cover classes (44). The ESPON SUPER project combined Corine and other key data into a publicly available spreadsheet,<sup>2</sup> allowing rudimentary monitoring of land take in Europe at the NUTS-3 level (Van Schie et al. 2020).<sup>3</sup>

According to this database, urban areas constituted a small fraction of European land cover in 2000 (4%) compared to categories such as agriculture (45%) and nature (51%). By 2018, the share had increased to almost 5%. While an increase of less than a percentage point may seem insubstantial, in absolute terms the amount of land take is considerable: about 1.17 million hectares (almost as large as the Austrian state of Oberösterreich), or about 184 ha per day. Approximately, 8.6 times more land was transformed into urban/artificial use than vice versa.

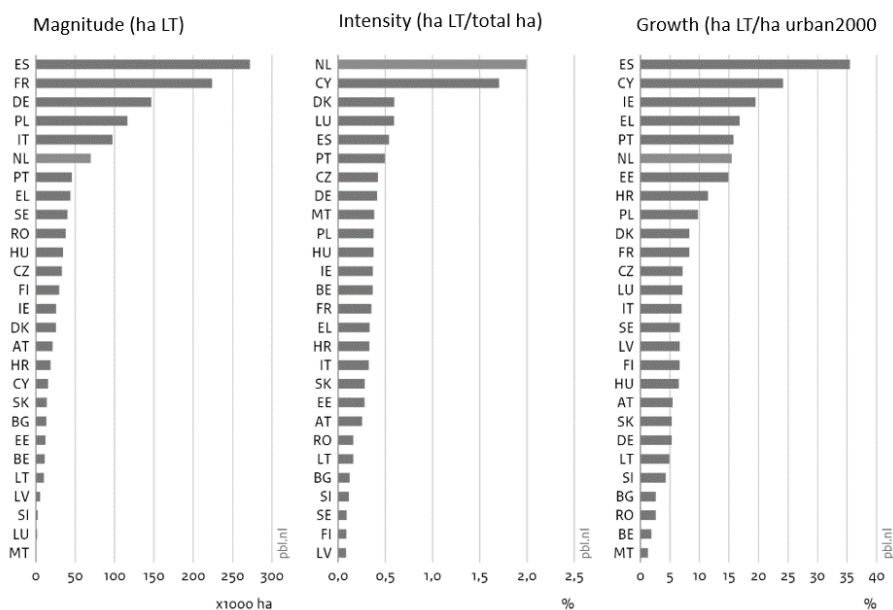


Figure 1: Land take in EU member states. Source: CHA/CLC, own calculations.

From a perspective of protecting a finite resource, the NNLT objective is understandable; the cited figures are far from zero. Still, five important caveats should be borne in mind.

<sup>2</sup> The database can be downloaded at: <https://www.espon.eu/super>

<sup>3</sup> In this section we refer to ‘Europe’ as the European Union plus several non-EU member states which have close ties, politically, economically and geographically with the EU. These are the United Kingdom, Switzerland, Lichtenstein, Iceland and Norway. This selection reflects the participants of the ESPON programme, which funded the research and is sometimes referred to as the ‘ESPON space’ (which, like the EU, evolves over time). Even though NNLT applies only to EU member states, other countries – notably Switzerland – have similar policies in place.

First, there is significant variation in land take across member states in absolute terms, intensity, and growth (see Figure 1). At present, the absolute value (magnitude) has gained most attention, but the other relative figures provide insight into how detrimental this is. A thousand hectares land take in a small, highly urbanized country means something very different from the same amount in a large country with large open spaces.

Second, Corine data is problematic for measuring urbanization in countries with very small-scale developments like Belgium. This is because the change is too small to be accurately observed. Either it is disregarded as a land-cover change entirely, or it falls within an area already designated as urban. The SUPER project performed an analysis of likely overestimations and underestimations per NUTS-3 region by comparing Corine to high-resolution GUF data for the same year (2012). Because the latter dataset makes no distinction between urban and rural functions, some of the discrepancy is due to definitions rather than errors in coding. For example, farmhouses, greenhouses or livestock sheds are built-up structures, whose ‘urban footprint’ is registered in GUF but coded as ‘agriculture’ in Corine.

Third, the Corine data shows a clear deceleration of land take over the 2000–2018 period: 44% of all conversions to urban use took place during 2000–2006, 35% in 2006–2012, and 21% in the 2012–2018 period. Many regions in central and eastern Europe were exceptions to this trend, as was almost all of the UK, which saw the most growth in the post-2012 period. Given the demographic outlook for Europe of low natural population growth, land take at the European level could be expected to continue to decline, but with significant regional variation. This raises the question of whether NNLT should be achieved at the EU level, within each member state, or within each region.

Fourth, different places have different development pressures. A stable or shrinking region will have much less difficulty reaching NNLT than a rapidly growing region. Unlike NNLT, the United Nation’s SDG11 indicator for sustainable urban development, urbanization per capita, takes this somewhat into account. A simple indicator states that if the growth rate of urbanization is lower than the population growth rate, it can be considered sustainable. However, this penalizes already dense areas. An alternative measure proposed by Schiavina et al. (2019), Marginal Land Consumption per New Inhabitant (MLCNI), is more balanced. Calculating MLCNI values for European countries yields a quite different picture than Figure 1 using the exact urbanization data. Heading the list, Portugal urbanized one hectare for every new inhabitant in the 2000–2018 period, followed by Slovakia and Cyprus. Malta, Belgium, Ireland and Austria had the most efficient urbanization. Furthermore, urbanization in Greece, Poland and Estonia occurred in the face of negative population growth (Evers, van Bommel, and Spoon 2023). This measure, of course, does not differentiate between natural growth and migration; the latter is more linked to economic development, which probably will entail more demand for infrastructure and industrial/commercial urban development.

Fifth, one can question the land-use categories used to calculate land take in the light of its underlying aim to conserve and improve soil health. One example is renewable energy (often coded as industry), which is often temporary and can leave soils intact (Cole et al. 2022). Moreover, a recent study examining the quality of ecosystem services (one of the arguments for NNLT) across Corine categories in the Netherlands found that agricultural land scored very poorly (approximately equivalent to urban fabric) and significantly worse than 'urban green' which is considered already taken (Evers, van Bommel, and Spoon 2023). While this can reflect the unique situation in the country under investigation (the Netherlands is renowned for intensive, export-oriented farming with a high share of livestock and horticulture) it does call into question the sanctity of CLC categories in defining land take. At present, clearing a pig shed for a golf course constitutes land take, whereas building over a city park does not. In the Dutch study, terrestrial nature clearly scored highest on delivering ecosystem services (Evers, van Bommel, and Spoon 2023). It is thus fortuitous that urbanization generally occurs at the expense of agricultural land (78%) rather than nature – only some Scandinavian countries (except Denmark), Croatia, Greece, Iceland and Portugal (as well as a few regions in Austria and Scotland) saw a majority of new urban land coming from terrestrial nature. However, even here, further investigation would likely reveal significant differences in soil quality among relevant CLC classes (e.g. deserts, permanent snow nature versus nature-inclusive agriculture). Such matters of definition can have far-reaching consequences: if urbanization of agricultural land is excluded from the definition, many countries would have a negative land take. The last word has yet to be said on this issue.

In conclusion, implementing a policy comprised of a generic rule such as NNLT is difficult to justify given the highly differentiated composition of Europe. The considerable territorial diversity makes it very difficult to create fair and accurate definitions. Ultimately some forms of urban development will be ignored, while others exaggerated due to vast differences in spatial structures. In addition to this quantitative element there is the question of implementation. Each member state has its own system of spatial planning which will be (potentially) responsible for bringing current urbanization levels down to zero. Each of these systems has its own idiosyncrasies and abilities. Many systems are oriented towards and only function in a context of growth and most regional politicians view growth as synonymous with success. Ignoring these matters 'on the ground' will make it very difficult to make progress on this EU objective.

### 3. Urban form in European regions

In 2006, the European Environment Agency issued a report where they labelled urban sprawl as an 'ignored challenge' in European policy (EEA 2006). As noted earlier, this is understandable given that spatial planning remains an exclusive competence of the member states. Still, this has not stopped the EU from supporting initiatives to study or curb sprawl. Like land take, urban sprawl is a normative term with a negative connotation, with the implicit assumption that it is unsustainable (cf. Bruegmann 2006; OECD 2018). For this



reason, the ESPON SUPER project opted for the more neutral term urban form or morphology.

Urban form/morphology is often determined by physical characteristics such as rivers, coasts and steep inclines, but is also affected by infrastructure and land-use decisions (e.g. Copenhagen's iconic finger plan). One useful dimension by which to classify urban form is its concentration in space (i.e. the region). For example, we can posit urban regions with a monocentric structure (Madrid, Berlin) at one end of the spectrum, more polycentric regions (Randstad, Ruhr area) of roughly equivalent distinct cores in the middle, and relatively diffuse urbanization (Flanders, Veneto) at the opposite extreme. The latter has an affinity with urban sprawl, as it usually concerns low-density and car-oriented development.

This continuum, referred to as 'nuclearity' by Galster et al. (2001), comprised the basis to gauge the urban form of all NUTS-3 regions in Europe. This was done on a Likert scale (1. Compact monocentric, 2. Compact-dual/linear, 3. Polycentric, 4. Polycentric-diffuse, 5. Diffuse) according to a visual assessment model (see icons in the middle of Figure 2). An indicator for the last category is ribbon development, as this is often associated with sprawl (Siedentop and Fina 2012, 2768).

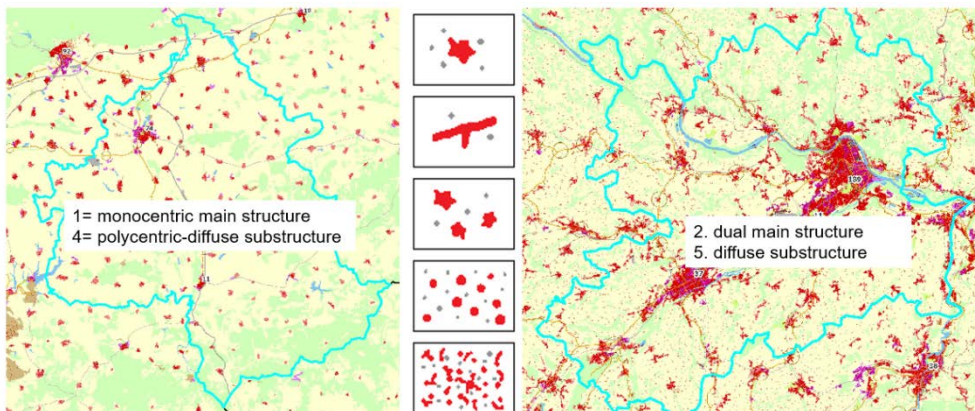


Figure 2: Application of the urban morphology assessment model.

Source: Van Schie et al. (2020).

During testing, it was discovered that a single measurement was insufficient to capture urban form as many regions contained multiple types. To account for this, the analysis was performed twice: once to classify the most prominent features (main structure) and a second time for the remaining area (substructure). Therefore, a compact monocentric city (type 1) could have a hinterland that was empty (1) or diffuse (type 5), producing a score of 1/1 and 1/5 respectively. This analysis, although ultimately based on 'subjective' human judgement rather than 'objective' computation (e.g. the OECD (2018) sprawl report which counts urban fragments per km<sup>2</sup> and high-density peaks), has the advantage of capturing this (sub)structure nuance (see Figure 2).

The analysis was performed by hand for all NUTS-3 regions in Europe for the situation in 2018 as well as for the changes over the 2000–2018 period. A first finding was that the most common urban structure in European regions was polycentric (main structures plus substructures). Not surprisingly, substructures tended to be more diffuse than main structures; the most frequent substructure type was polycentric-diffuse, whereas this was polycentric for the main structure followed closely by compact. In general, more diffuse main structures were accompanied by more diffuse substructures. Interestingly, the analysis also found that the most diffuse substructures (i.e. sprawl) was as common around monocentric as polycentric regions. A seminal study on this topic had similar findings (Siedentop and Fina 2012). There were also clear territorial variations. Compact morphology is more prevalent in southern and northern Europe, whereas central Europe gravitates towards polycentric and diffuse (see Figure 3). Aggregating scores to the national level show Hungary, Poland and Slovakia to possess the most diffuse substructures.

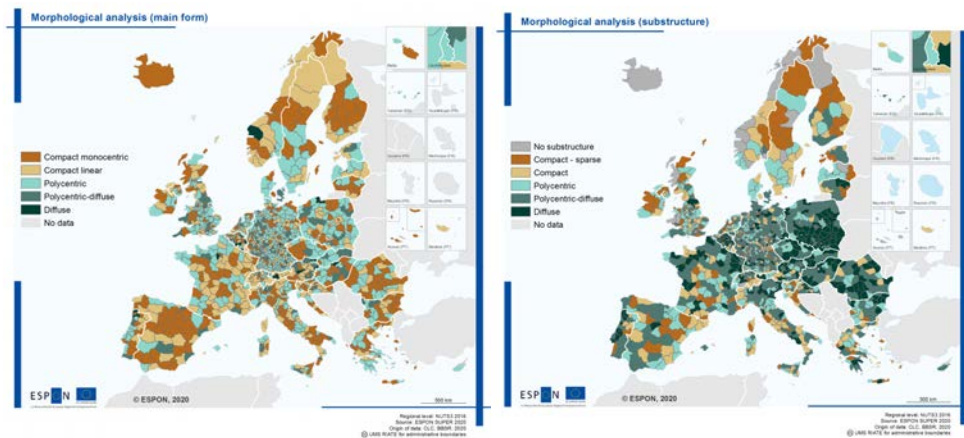


Figure 3: *Urban structure (left) and substructure (right) of European regions.*  
 Source: Van Schie et al. (2020).

The dynamic analysis revealed that the main structure in Poland and northern England became more dispersed in the 2000–2018 period, whereas new development in Spanish regions was far more compact. Fragmentation of the substructure was more common, although less so, in Scandinavia and the Baltic states. Interestingly, recent urbanization in Hungary, the Czech Republic and Slovakia was compact even though the overall substructure is relatively diffuse. All this demonstrates that morphological development is partly, but not completely, path dependent, suggesting that spatial planning and other public policies may have an impact on how urban form evolves (Evers et al. 2020).

The availability of a quantitative measure for urban form across NUTS3 regions allows comparison with other indicators. For example, we can investigate how urban form relates



to the concentration of population over cores.<sup>4</sup> An initial analysis found, counterintuitively, that regions with a lower primacy rate (more dispersed population) tended to have more compact urban forms than regions with a clearly dominant core. This relationship was most pronounced in the substructure, yet still visible in the main structure. Less surprising was the finding that regions with higher populations overall leaned towards more compact urban structures. Additionally, these regions exhibited more compact development (e.g. infill or contiguous rather than discontinuous) during the 2000–2018 period (Van Schie et al. 2020). It should be noted that all this concerns an initial analysis; more sophisticated research – for example, by using grid cells to account for administrative border biases – is needed to confirm these findings.

Although it is tempting to automatically label regions with diffuser substructures as less sustainable, a regression analysis performed on the results of the SUPER morphological analysis against various sustainability indicators produced largely inconclusive results: only the most diffuse category scored significantly lower than the rest on the self-constructed sustainability index value. Other variables such as affluence (GVA per capita) proved much better predictors for sustainability than urban form (Lardinois 2021). Again, more sophisticated analyses will need to be performed to determine whether these initial signals are correct.

#### 4. Conclusion

It is too easy to dismiss all urban growth (land take) and dispersal (sprawl) as inherently unsustainable. Not only should both be evaluated in relative terms, but the notion of sustainability should be interrogated as well. The SUPER project, for example, took a broad perspective by drawing up a multicriteria assessment framework to evaluate urban form using the familiar environmental, economic and social dimensions (Evers et al. 2020). This exercise revealed tensions not only between dimensions, but also within dimensions (e.g. environmentally, compact development was positive for greenfield preservation and energy efficiency, but negative for air pollution concentration and heat-island effects). Given these trade-offs, urban development and urban form should ultimately be considered a normative decision rather than a technical one. Bearing this in mind, we can revisit the title of this chapter and consider whether the various analyses of the changing urban landscape of Europe cited here can be considered sustainable.

With respect to land take, the decline in fertile soil delivering essential ecosystem services in the 2000–2018 period due to urbanization is a valid sustainability concern. Far more land is converted to urban use than vice versa, and the damage is often irreversible. Framing urbanization as ‘land take’ suggests that the action is unwarranted or even illegal (as opposed to buying, using, developing) and that land is disappearing. In reality, land is being converted to other uses, sometimes for very legitimate reasons given acute housing shortages

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<sup>4</sup> For this we use the primacy rate (the ratio between the largest urban unit (measured at the municipal/LAU level) and the total population in the NUTS 3 region).

in many European regions. An economist would interpret the same phenomenon positively as increasing land values, and thus welfare (whether or not it is economically sustainable is however open to debate). Spatial planners are more ambivalent, and usually try to strike a balance between competing interests within a particular territorial context. They strive to arrive at a responsible material land-use decision, fully aware of the possible consequences of that decision for the unique qualities of an area. These decisions are ideally made in collaboration with stakeholders and after a public debate about the future of the area. As NNLTL is quantitative, generic, and absolute in its approach, it risks alienating the planners who will ultimately be responsible for implementing it. In line with the proportionality principle, it may be wise to explore less drastic and more direct alternatives to NNLTL for improving soil health in Europe. This could be done, for instance, by tightening environmental standards on soil pollutants and adjusting conditionality for agricultural subsidies as well as promoting nature-based solutions.

So how, as spatial planners, should we view the fact that over one million hectares of land was urbanized in Europe in the 2000–2018 period? First, we should note the trend of decreasing urbanization and the divergent regional trajectories. Second, and more importantly, we should evaluate whether the new buildings, parks and infrastructure were responses to societal needs, or more supply driven (landowners seeking profit). More sustainable land-use practices are certainly needed in rapidly urbanizing regions with declining populations. Third, the quality of planning should play a role: taking land for an out-of-town shopping mall with hectares of parking is different than taking the same amount of land for a walkable mixed-use neighbourhood with ample green space.

Although policies to affect the development of urban form is not a competence of the European Union, there are clear links with sustainability which *is* a key priority. There is a vast body of evidence showing the environmental costs of urban sprawl. This literature should be viewed critically to avoid tautologies (some definitions of sprawl include its causes and/or impacts) and normativity. The regional classification of urban form and sustainability assessment in the SUPER project could be used as a starting point to this end. Still, like land take, discouraging diffuse urban forms should not be seen as an end in itself. And, like land take, there can be good reason for this kind of development (e.g. an ‘off-the-grid’ self-sufficient eco-community), even with respect to environmental sustainability. Sustainable urbanization will ultimately require a territorially differentiated approach.

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# Could Land Management be the Immune System of Sustainable Land Development?

## Abstract

Sustainability is supposed to be the main goal of land management and therefore the Sustainable Development Goals should be balanced for public welfare. However, the economic framework of neoliberal doctrines makes it difficult to put any sustainable development goal first than economic growth. This article points out how land management could learn from the immune system, because the immune system aims to keep us healthy, which refers to sustainability. Beyond, it is not only the aim land management could learn from, but also the approach how to reach the Sustainable Development Goals.

## 1. Introduction

In 2015, the United Nations adopted 17 Sustainable Development Goals (SDGs) that are supposed to be interlinked as action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability. Thus, land management is considered as sustainable if it meets economic, ecological and social demands in the longer term. More precise we can say that sustainability in land management means to balance all demands on consumption of natural resources respecting the planetary boundaries but also guaranteeing well-being in the long term.

Many publications so far have addressed and structured the impacts of land use (an overview is given by Nuissl and Siedentop 2021). In a recently published contribution collection Weith et al. present and discuss a wide variety of challenges and possible solutions with regard to the sustainable use of land. However, all of the authors agree, that the current use of land is far away from being sustainable (Weith et al. 2021).

Addressing the multiple interconnections of activities in spatial context needs an effective and at the same time fault-tolerant approach. Our aim is to go in greater depth into two topics:

- The balancing of interests in land use is a great challenge in view of the many aspects, since all of them are very important. There is a wide margin of discretion. The question is how the weighing can be done seriously without falling into arbitrariness when neither laws nor regulations can explicitly specify the criteria?

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- How to identify the necessary measures and to implement them quickly and effectively? With many stakeholders, planning is often a time-consuming process while the need for action is high. This requires adapted forms of governance. We think it is worth to take inspiration from the utmost efficient immune system's approach and look for similarities.

## 2. Balancing interests: Facts on trends of sustainable development

In the European practise of land management economic growth (SDG 8) is the hidden star among the sustainable development goals. Almost all land management instruments are based on growth. From land use planning to value capturing, growth is the basic idea (Xue 2022). This concentration on economic growth leads to major distortions in the other objectives of sustainability and ignores that the description of the UN-goals states that economic growth has to be seen in accordance with national circumstances. Economic growth is mainly important for the least developed countries. In particular, hopes are set on it in the fight against forced labour, modern slavery and human trafficking and also to consolidate the prohibition and the elimination of the worst forms of child labour (United Nations, 2015).

The urgency of fulfilling both, the ecological as well as the social demands is still underestimated. At a first glance, the Swiss indicator system "MONET 2030" seems to show, that growth of the gross domestic product (GDP) goes hand in hand with a decrease of the material footprint per person (Figure 1). However, the example shows that we have to be careful with such hasty conclusions on a cause-effect relationship. In fact, economic growth without resource consumption is impossible (Hickel and Kallis 2019).

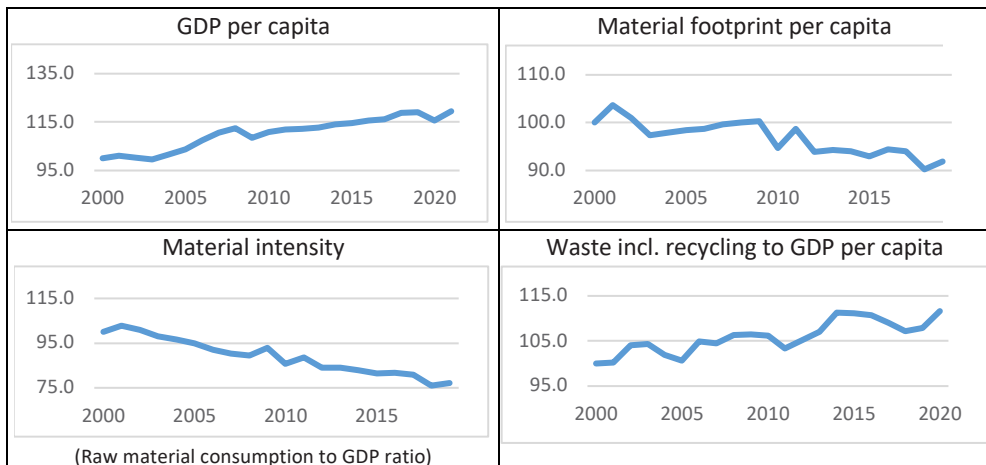


Figure 1: Comparison of GDP growth with material consumption. Index 2000 = 100  
(Source: Own charts based on data from Swiss Federal Statistical Office, n. d.).

A more detailed analysis shows that the materials used in the building sector play the most important role in material footprint. 40% of annual global resource flows are due to construction materials including metals and non-metallic minerals such as concrete and ceramics (Heeren and Fishman 2019). Pothen and Welsch (2019) analysed data of 144 nations and found that economic growth under status quo policies does not limit the use of materials. Mostly, the contrary is observed (see e.g. Pradhan et al. 2017; Karakaya et al. 2021) but there are major differences between the countries of the EU. In Switzerland, 4.5% less material was used in the last ten years, building construction and civil engineering together. In addition, fewer concrete but a little more wood was used (SBV 2021). This largely explains the decline in the material footprint.

A broad systematic review of global data highlights that a relative decoupling of GDP and resource use can be observed due to technology-driven gains in resource efficiency. But decoupling is not expected to be a permanent part of development. In contrary, raw material consumption keeps growing and GDP growth is even a major factor for this along with population growth (Haberl et al. 2020). This is in line with the results of MONET 2030 regarding waste.

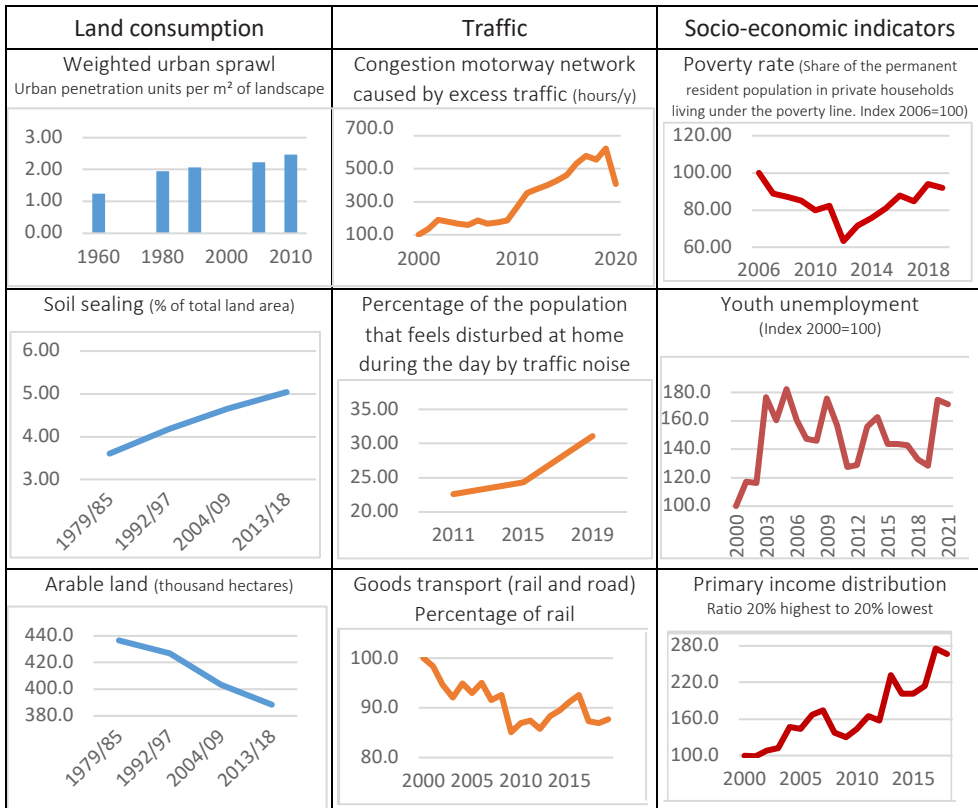


Figure 2: Indicators demonstrating a non-sustainable development in Switzerland (Source: Own charts based on data from Swiss Federal Statistical Office, n. d.).



Looking at the other MONET 2030 indicators, most of those who are relevant to land management, including socio-economic factors, counteract the desired development. Figure 2 covers indicators for land consumption, traffic and socio-economic development. All of them show a negative trend for sustainability (poverty rate since 2012) while the GDP grows continuously.

For land management it should be noted that indicators aggregated over the whole country show the overall trend but are not representative for the concrete regional and local development. Other statistics are often more meaningful for the project-oriented weighing of interests. For biodiversity, watercourses and flood protection regional and local data are essential. In summary, it is clear that it is irrational to believe that we can split the use of resources and growth. Unlimited growth is basically an exponential function which as such can never be sustainable. It has to be confronted with the fact, that ignoring the ecological limits of growth is extremely life-threatening. Overpassing of ecological limits on the long term will end in ecosystems collapsing, with fundamental regional or even global consequences for the living conditions. The latest analyses of climate research indicate that the Earth's tipping elements are more unstable than previously suspected. Five tipping points could be exceeded with as little as 1.5 degrees of warming (Armstrong McKay et al. 2022).

The destabilisation of the socio-economic equity is no less serious. If we miss to balance socio-economic issues, mutual spatial dependencies risk undermining the living together in society (Tammaru et al. 2015). The effects range from alienation to social division and high vulnerability of living conditions including supply chains (Coenen et al. 2018, Keeler et al. 2019, Giljum et al. 2016).

For all these reasons, we seek for points of orientation not growth-dependent.

### 3. Key points of orientation for sustainable development measures

From a legal point of view, the planning principles are the first point of reference for every spatial planning measure. They contain essential specifications on how sustainability is to be implemented in land management. All these planning principles need be taken into account in a comprehensive manner according to the spatial context. However, this is not sufficient. Under sustainability aspects, the economic, ecological and social demands are to be satisfied also in the longer term. The outcome should not only appear to be balanced for the moment, but should also provide fair results across generations, according to the changes that will be caused in reality. In particular, doing nothing also has an impact.

Spatial planning has always restricted and guided private use in order to protect resources, to balance interests and to serve the common good. That is indeed its function. However, compared to sustainability concerns, the balancing has been relatively short-term, often dictated by sectoral project planning. A long-term point of orientation is lacking, or the wrong one, namely growth, has been chosen. The diversity of the demands and of the spatial use options makes it necessary to agree on a common orientation for balancing the issues of

the different legislations in a cross-sectoral way. Such a point of reference is constitutional in nature.

### 3.1 Concept of spatial justice

The fundamental principle is fairness, expressed in ideas of justice. The concept of “spatial justice” was developed more than 50 years ago, almost at the same time as the first report of the Club of Rome on the limits of growth, considering a projection of “social justice” onto space (Uwayezu and de Vries 2018). The advantage of the concept was initially the open nature of the philosophical discourse. In the urban environment, spatial justice is closely linked to the term “right to the city,” which was coined at the same time by Henri Lefebvre. It refers to the possibility of participating in urbanity as a meeting place, i.e. the right to shape and enjoy classic urban amenities like connectivity, culture, public services, economic security, and decent housing (Lefebvre, 1968, Cohen, 2018).

In the meantime, however, spatial justice has gained more binding force. In Germany, since the second half of the last century, the postulate of spatial justice has been increasingly anchored constitutionally in the welfare state clause of the “Grundgesetz” (in-depth Volkmann 2018). Today it is joined by the constitutional basis of intergenerational justice, which was confirmed by the German Federal Supreme Court in its ruling BVerfG, 1 BvR 2656/18 (2021). Koppers et al (2018) distinguish four components of spatial justice: distributive justice (namely access to infrastructure), procedural justice (opportunity to participate), equality of opportunity (capability) and intergenerational justice. Spatial justice and its constitutional basis are currently at the core of the discussion about a new spatial model, in particular for a fair balance of interests between cities, urban hinterland and rural areas (Miosga 2020, Weith et al. 2022).

For Switzerland, it can be noted that the essential components of sustainability have been expressly indicated as a state purpose (Art. 2 of the Swiss Federal Constitution [BV]). Furthermore, sustainability in terms of a balanced relationship between nature and its capacity for renewal, on the one hand, and its use by humans, on the other hand, was inserted as the first article in the constitutional section on environment and spatial planning, claiming validity for the other articles of this section (Art. 73 BV). Although no directly applicable directives for measures can be derived from all these statements, a program mandate can be derived: an obligation to pursue their realization within the framework of the state's activities.

This shows the advantage of a constitutional basis over a “merely” philosophical concept: it is at least indirectly binding (cf. Rausch/Marti/Griffel 2004, who speak of a “richtungsweisende Wertentscheidung” [direction-giving value decision] of the constitutional legislator; for Germany see Schuppli 2020). Admittedly, the targets are formulated in an open manner and the concretisations in the legal planning principles leave open a large margin of discretion. However, this discretion is not to be used arbitrarily, but dutifully, i.e.

according to the intent and purpose of the law, which is also to be interpreted in the light of the constitution.

### 3.2 Concretisation: Spatial justice as a requirement for spatial measures

If there is a wide range of possible measures, then the question is: Which are efficient enough to meet the urgency of actions? And which of these are both just and reasonable? To justify measures, we not only need to know which unsustainable land management practices of regions can have serious consequences for the society as a whole. We also need a strategy for tackling successfully under conditions of uncertainty because many tasks demand that we cannot wait for detailed guidelines to be worked out, even if this would be important for reasons of legal certainty.

There is already a rich literature that increasingly addresses spatial justice. Weith et al. (2022) highlight the current discussion. They show a strong degree of fragmentation, running the risk of losing the overview. This has disadvantages for the implementation of the idea of justice. In our view, it is important not to lose focus: It is the spatially produced inequalities, the positive and negative impacts of land use conflicts, that offer approaches to develop supra-municipal governance instruments (Weith et al. 2022). On the other hand, the debate on planning law that focuses on the equivalence of living conditions, urgently needs to be supplemented if the idea of growth is not to spread again through the back door (see below).

### 3.3 Spatial justice as a barometer for the need for action

There is a risk of returning to the idea of growth if minimum standards, e.g. for infrastructure provision, are justified merely with the argument that this is necessary to guarantee regions and municipalities equal “development opportunities”. If the term “infrastructure” refers primarily to transport, waste disposal and energy infrastructure, then this already lays the foundations for further urbanization of the landscape. Development is only sustainable if it simultaneously addresses the renewability of ecosystem services in the specific regional or local context. “Ecosystem intergenerational justice” sets limits to further development insofar as land use is based on sufficiency criteria rather than on the satisfaction of potentially expanding demands, such as the continuous increase in per-capita residential space.

The Canton of Zurich’s Structure Plan provides an example of linking land use to sufficiency. To maintain sufficient crop rotation areas, they are probably developed only, if there was an overriding public interest and compensation was ensured. Such compensation is achieved by qualitatively improving the suitability for agronomic land use of another site of the same area in such a way that these reconstructed soils meet the criteria for crop rotation areas (Kantonsrat ZH 2022, pt. 3.2.3). The upgrading is done by specialized enterprises that, under pedological supervision, technically correct deposit unpolluted soil material on anthropogenically already influenced soils. The larger the affected crop area, the more difficult it is to find a suitable compensation area of the same size. This is also the case in Germany according to the German Nature Protection Law.

If further development reflects both negative trends and sufficiency, measures for the renewal of buildings in already overbuilt areas and such for the deconstruction of buildings will move to the foreground. In any case, the use of resources and their renewability need to be in balance. This would mean, for example, that urban renewal in the sense of social justice should strive for a reduction of overpriced housing in favour of affordable housing. Accordingly, the new distribution conflicts will be intense. Furthermore, they will become more intense the scarcer the available land is and the longer the goal of growth is maintained in spite of this.

#### 4. Target-oriented action: Learning from the immune system

To explore the question of how to identify a high need for action and how to initiate appropriate measures, we took inspiration from the utmost efficient immune system. This strengthened our view for a problem-oriented approach in land management.

A very short overview over the immune system is given in the appendix. In this paper we will focus on the comparison with land management. We will discuss the functioning of the immune system only as it is necessary for understanding the comparison. Our aim is to give an idea of what we can learn from the immune system's way to proceed. In our comparison unsustainable land use corresponds to pathogens that try to invade the human body to multiply. And this is what we got: we need monitoring and combine spatial findings to detect potentially unwelcome structures (see 4.1) and co-working over sectoral limits (4.2).

##### 4.1 Spatial law and spatial monitoring to retrieve unwelcome structures

Our immune system detects pathogens and is able to react immediately. This is based on two parts of the immune system, the initiate and the innate one. In land management we also have two systems, the legal framework and spatial monitoring.

Everybody is born with the so-called innate immune system. The innate immune system is made up of physical-chemical barriers like the skin and exists secondly of defence cells. These cells recognize specific molecular patterns found in microorganisms which evolution has since a long time known to be harmful.

Regulatory success needs monitoring

In land management "barriers" are established by the basic legal frameworks of planning and land management. Like pathogens, which cannot penetrate the body without causing harm, the legally unwanted land use cannot take place without violating the law. Land uses that are incompatible with the existing usage regulations are brought under control through directives such as use bans and deconstruction orders with the goal to retrieve the lawful state. In comparison, these are white blood cells or the killer cells that destroy pathogens by killing and eating them.

However, our equivalents to killer cells are used reluctantly, often only after intervention by neighbouring residents which means with a bigger time delay. This statement is supported,

e.g., by the annual report of the Zurich Administrative Court (Verwaltungsgericht ZH, 2021) and by surveys from a Master thesis (Vetterli, 2017). The comparison with the immune system indicates, that the control mechanisms in land management show weaknesses and need to be reviewed.

In the innate immune system, we recognise specialised passively in the body circulating proteins that can be compared with monitoring: If they find foreign substances, they mark them and send messenger substances to stimulate the immune response. However, there are differences: The “monitoring” of the immune system is rather a just in time monitoring. The spatial monitoring on the other hand is usually retrospective, often not object-related but generalized, working with aggregated data. And it triggers no direct consequences.

Therefore, we assume that if we want to combat unwanted land use efficiently, our local monitoring should also be more “just in time”. And it should alert the authorities.

#### Focus on unsustainable structures

Viruses have developed strategies to circumvent host innate immunity. That is why human beings all develop a second immune system, the so called adaptive (or acquired) immune system, which is acquired in the course of life. It is composed of specialized, systemic cells and is meant to eliminate pathogens or to prevent their growth. Unlike the innate immune system, which is pre-programmed to react to common broad categories of pathogen, the adaptive immune system is highly specific to each particular pathogen the body has encountered.

The acquired immune system can fight previously unknown pathogens efficiently and relatively quickly. In a first step, the so-called dendritic cells (DZ) become active. They are specialized in examining structures foreign to the body in order to determine whether they are equipped with so-called antigens. Antigens are specific exposed molecule segments<sup>1</sup>.

In land management monitoring corresponds to this first step. The challenge is to identify as early as possible the cause of unsustainable developments by analysing the situation and discovering the weak points, where it is promising to develop counterstrategies. In land management institutionalized monitoring covers mainly numerous sustainability indicators, from soil sealing, ecological changes (air, water, climate, biodiversity, undeveloped soils) to social changes, especially concerning the situation and happiness of the population. The Swiss indicator system “MONET 2030” lists a total of 103 indicators (Swiss Federal Statistical Office, n. d.).

The further procedure follows this sectoral approach. The indicator-development is weighted to determine sectoral sub-targets (e.g. for transport). If a need for action is identified, measures and investments are explored sector by sector. We note that, in contrast to the immune system, it is not the specific structures in their combination that are initially

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<sup>1</sup> The term antigen has nothing to do with genes, but is derived from antibody generator.

investigated, but each individual element separately. Such intentions do not include other spatial characteristics and needs, at least not from the beginning. Examples are economic incentive systems, protection against evictions from rental apartments, building terms and conditions, compliance with the plant limit values of the environmental law, increasing the density of built-up areas, enhancing the agricultural productivity, social housing, support for “qualitative” growth etc. This is a significant difference. The DZ’s detect directly potentially unwelcome structure sequences, they analyse them and locate where antibodies can doc.

How to combine spatial findings to detect potentially unwelcome structures?

If we focus on spatial needs, the possible sustainable ways of shaping the development differ from area to area, and the need for protection also varies locally and regionally. If we concentrate on the concrete regional or local development right from the outset and not afterwards, supplementary monitoring is necessary. It starts with the potentials and sensitivities of the areas. In practice, this kind of monitoring is most advanced where spatial, constructional, agricultural, ecological and cultural-historical data are mapped. The Geographical Information System of the Canton of Zurich gives access to more than 200 maps of open Geodata, most of them relevant for land management (GIS-ZH, n. d.). By overlaying the maps, obstacles and opportunities can be discovered more easily which facilitates decision-making and generates a more precise, fact-specific response (Hepperle and Stoll 2006). Such an approach corresponds to the one of the immune systems that identifies particular structures in their combination.

Moreover, only an overall view shows if and where there is an overriding public interest in implementing countermeasures. Examples for a more integrating approach are the watershed management or the way habitats are interlinked. It is a mistake to consider only one indicator as the primary guarantor of sustainable development. Especially economic development must always be seen in the context of ecological and social side effects.

What attracts the attention, however, is that such representations for social conditions and developments exist only very sporadically, if at all. Many researchers therefore use proxy methods to localise the status of social well-being, especially by looking at cultural ecosystem services (see e.g. Nowak-Olejnik et al. 2022).

We are convinced that an integrating approach also meets the concerns of project-developers interested in sustainability. Spatial allocation needs data with a concrete spatial reference (Henning et al. 2021). If monitoring provides not only information based on existing spatial data but also processes them in such a way that they can be spatially combined, then it should be possible to filter out typical structures which normally lead to problems. This allows to continue in a much more targeted manner and saves time. The benefits of forward thinking in planning become particularly clear when it comes to projects designed to protect against natural hazards.

## 4.2 Co-working over sectoral limits

Organizationally, the immune system relies on different responsibilities from the very beginning. The “spatial analysts” (DC’s) are permanently active. If they recognize something exceptional, this circumstance triggers the action. They migrate to the next lymph node, where they present their findings to so-called T cells. These process the information of the detected “peculiarity” in such a way that the immune response can be triggered. They develop own cell structures that resemble the conscious antigen and contact others, the B cells, which prepare the action packages in the form of antibodies that precisely match the antigens according to the lock-and-key principle. This allows neutralisation of the antigens – but if they do it is under the supervision of regulatory cells which amplify or reduce the reaction to avoid over- or underreacting.

For the land management this would mean that there is a direct, non-hierarchical exchange of information between those who do the monitoring and all those specialists who process the knowledge for the policy-makers in such a way that they are able to handle it. The aim is not to prevent certain activities as such, but to suppress those who, in the given combination, trigger the unsustainable behaviour.

It should be noted, however, that ad hoc measures-packages encounter administrative obstacles in current practice. If, for example, a construction project is pending, the influences on habitats, water bodies, water and nutrient cycles, soil functions (including the question of where to dump the excavated material), etc. are initially considered only superficially. They are each assessed by different specialist units which want to be informed about the concrete dimensions and special features of the upcoming project. Then they give their opinion to the leading administrative office through the office consultation channel. Moreover, the impact on social well-being is directly visible only among those affected by the replacement or renewal of old buildings. Neighbourhood changes, on the other hand, take place only gradually and must first become politically manifest before concrete measures are considered.

The described deficiencies were recognized by policy-makers. In Switzerland, the requirement to involve other authorities, affected organizations and persons as early as possible is anchored in legislation, at least for federal activities (Art. 18 para. 1 of the Spatial Planning Ordinance) and for projects subject to environmental impact (Art. 10a para. 1 of the Federal Act on the Protection of the Environment (Umweltschutzgesetz, USG). Moreover, the Federal Supreme Court deems it appropriate that land use planning has to identify conflicts of interest as early as possible and to find suitable solutions instead of postponing them to subsequent steps (design plan or building permit procedures; BGer 1C\_315/2015 E. 6.1). Art. 4 para. 2 of the Spatial Planning Ordinance requires of the Cantons that their sectoral plans have to indicate the factual and legal circumstances and the foreseeable land-use conflicts and that they have to contain an assessment of the possible developments from an overall perspective.



However, in practice, the Canton Zurich does know so called “fachübergreifende Gebietsplanungen” (cross-sectoral territory planning), but only areas with special urban development potential, a great need for coordination and action, and a high density of public buildings and facilities of cantonal interest are object to such a procedure (Kantonsrat ZH 2022, pt. 6.1.1). Besides, overall packages can occur if projects are subject to an environmental impact assessment. In other cases of already spatially concretized projects, unfortunately, measures can only be put together in a fragmentary manner. A more comprehensive view can, at best, be taken in design plans that not in accordance with the general development planning and therefore need an adoption according to the planning procedure.

It follows that sustainable land management depends on new models of cooperation that intervene at an early stage.

## 5. Conclusion

Coming back to our title question: Orientation to the immune system could actually make land management a more effective tool for achieving sustainability. But first there have some requirements to be fulfilled.

- The concepts of spatial development require revision. Growth is not a helpful orientation. Spatial justice is much better suited as a barometer for the need for action.
- Monitoring should not only be based on indicators; it is particularly important to focus from the outset on locally or regionally unsustainable combinations of spatial structural elements. As a keyword, integrating approach can be mentioned.
- Deficits in terms of cross-sectoral cooperation need new early-stage co-working structures.

In other words: If we can ensure that the weighing of interests in spatial planning is based on facts and on the requirements of justice geared to the specific spatial conditions, and if we also move away from hierarchical and responsibility-oriented thinking, then land management has a real chance of being fit for the future. The interesting thing about this is that it is much more a question of approach than of fundamental legislative revision.

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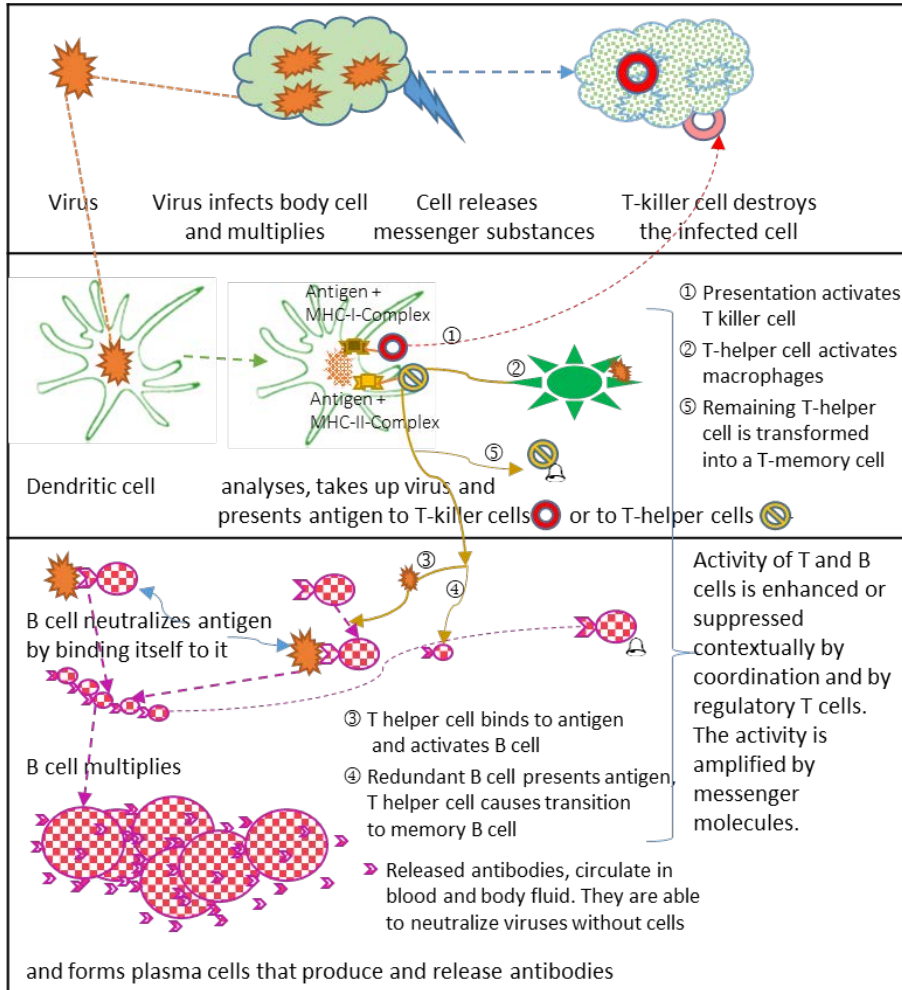
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Appendix

Combination of the innate and the adaptive immune response: Schematic overview.



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# Contesting Mining Activities in Turkey: The Case of Artvin Cerattepe<sup>1</sup>

## Abstract

Mining activities contribute to the development process by providing national income, an increase in employment, and export income. On the other hand, mining creates irreversible changes to the physical environment as well as creating social and environmental burdens. These matters should be given their due attention in planning decisions and Environmental Impact Assessments. Still, mining activities are carried out in many conservation areas with very high ecological value in Turkey, exposing them to ecological, social, and economic threats. Artvin Cerattepe is a case in point: there has been decades of conflict over land use permits to perform mining activities, involving stakeholders both national and international and mobilizing grassroots resistance. This paper recounts this conflict and highlights critical factors which could be useful for opponents to environmentally damaging economic operations.

## 1. Introduction

The problematic of the research is that the EIA, which is a very important tool that should be used when making environmental protection and land use decisions, unfortunately cannot be used effectively in Turkey due to the prioritization of economy over the environment by the executive and judicial powers. The mining exploration activities in Cerattepe are a case in point where this problem is fully realized. As a methodology, a chronological approach to the mining exploration activities and environmental protection efforts in Cerattepe was necessary. The EIA reports prepared for these activities, the EIA Positive Decisions issued by the relevant ministry in line with these reports, and the judicial decisions taken on these decisions of the ministry are discussed chronologically. It should also be noted that information about this process in Cerattepe could only be obtained from the sources of professional chambers and local voluntary environmental protection organizations, as well as news reports in the press.

Cerattepe is the name given to the summit of one of the hills on the slopes of Artvin in the Turkish Black Sea region. It is adjacent to urban settlements, includes the Artvin Kafkasör Tourism Protection and Development Zone, and is next to the Hatila Valley National

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Park. It is one of the places with the richest vegetation in Turkey and the world, a major migration route for birds, and possesses ample mineral resources, notably copper, silver and gold. For this reason, it is also the site of environmental degradation and is under continual threat from mining operations.

The motto of the people of the region is “The top of Artvin is worth more than gold (under)”. The word “gold (under)” here is used both in the meaning of “under the ground” and “gold”, which is a precious mineral. What is meant by the “top” of Artvin is the ecological wealth that Artvin Cerattepe has.

Drilling operations for mineral exploration in Cerattepe go back to the 1980s. The Region’s richness in gold, silver, and copper ore led to the start of mining activities, and the subsequent environmental damage of gold prospecting and the separation of gold from copper. The mineral exploration area is in a landslide zone, and as trees are cut for extraction, this will make the problem worse. The operations are also expected to pollute water resources in the area. Moreover, there is also a concern that the region’s cultural, touristic, and ecological wealth will be damaged due to mining activities because there is Kafkasör Plateau in the lower part of Cerattepe, Hatila National Park on the right, Urban Forest on the left, and Atabarı ski resort behind it.

In Cerattepe, gold, silver, copper, and zinc exploration licenses have continuously changed owners between foreign and Turkish companies. A lawsuit was filed to revoke the license of the enterprise by the Green Artvin Association, which was established in response to mining activities, and the Artvin Bar Association, claiming that the risk of landslides and the health of the people of the region would deteriorate. The courts concurred and the license was retracted.

However, the mining operation license was put out to tender yet again. As a result, the Ministry of Environment and Urbanization approved the EIA report prepared by the company that received the license, finding it positive (Cerattepe Bakır Madeni ÇED Raporu, 2015 (Cerattepe Copper Mine EIA Report, 2015)). A subsequent lawsuit filed by Green Artvin Association proved successful, and the Ministry’s approval of the EIA was overturned. However, the company prepared a new EIA report by making minor changes to the project and again received a positive EIA decision from the Ministry. As a result of these developments, a substantial environmentalist movement started against prospecting activities in Cerattepe. In the meantime, the Ministry’s recent positive decision on the EIA was also retaken to the judiciary. While the litigation process was ongoing, it was observed that the mining exploration company’s work machines started operating in the region. The Competent Court decided that mining activities can be carried out in the state forests if the necessary permission is obtained and the necessary permits for the mining project in question have been obtained. Today, however, it is observed that mineral exploration activities continue (<https://tr.sputniknews.com/cevre/201707061029159311-danistay-cerattepe-madencilik-onama/> (Last access: 29<sup>th</sup> March 2019)).

As Figure 1 shows, Artvin province is located in the North East of Turkey, close to the border with Georgia. Cerattepe is the name given to the summit of one of the hills on the slopes of Artvin province in the Black Sea region. It is one of the places with the richest vegetation in Turkey and the world, one of the migration routes for birds, and almost the entire area where the project is intended to be implemented is forest land. Cerattepe is adjacent to the urban settlement area, includes the Artvin Kafkasör Tourism Protection and Development Zone, and is next to the Hatila Valley National Park.



Figure 1: Geographical Location of Cerattepe. Source: TMMOB Report, 2014.

Figure 2 below clearly shows the natural beauty of Cerattepe before the start of mining activities. However, the land use decision to allow mining exploration activities was not taken to protect the ecosystem in question, but for the economic benefit of the mining activity.



Figure 2: Cerattepe before the start of mining activities. Source: bbc news, 2016; [https://www.bbc.com/turkce/haberler/2016/02/160223\\_dokuz\\_soruda\\_cerattepe](https://www.bbc.com/turkce/haberler/2016/02/160223_dokuz_soruda_cerattepe); Last access: 29<sup>th</sup> September 2022).



The current licensee mining company is only licensed to mine copper. In addition to the copper mine, there are also very rich gold deposits in the region. Due to the combination of gold and copper mines, the local people are worried about the possibility of mining gold here. Because it is known that the processes of gold exploration and separation of gold from copper harm the environment. The fact that the mineral exploration area is a landslide zone will become even more dangerous due to the cutting of trees for mineral exploration activities. It will also cause pollution of water resources in the area. On the other hand, there is also a concern that the region's cultural, touristic, and ecological wealth will be damaged due to mining activities because there is Kafkasör Plateau in the lower part of Cerattepe, Hatila National Park on the right, Urban Forest on the left, and Atabarı ski resort behind it.

## 2. Mineral exploration and extracting activities

Mineral exploration and extraction activities contribute to the development process by increasing national income and employment. However, they create significant negative environmental externalities. For this reason, an Environmental Impact Assessment (EIA) should be performed for mining activities. The rule of conducting EIA in Turkey was placed in the Environmental Law that entered into force in 1982. The rules regarding which activities are included in the EIA process and how this process will work are determined by the Environmental Impact Assessment Regulation issued in 1993, ten years after the law. In the meantime, it is observed that the Environmental Impact Assessment Regulation has been amended many times since 1993 and that some investments, activities, or projects that harm the environment have been tried to remove from the EIA process. Among the economic activities mentioned in the regulation, there is also mining. Since mineral exploration activities often harm the environment, it is necessary to determine, monitor, prevent, and eliminate the possible negative effects on the environment in the short and long term, or take the necessary measures or abandon that activity.

Before starting mineral exploration and extraction activities should be taken into account, soil characteristics, land use capability, flora and fauna in the region, endemic species and their habitats, forest areas, protected areas, urban and rural land use patterns, economic characteristics of the region, social structure and infrastructure of the region, geological and hydrological characteristics of the region, forms of underground and surface water use, meteorological and climatic characteristics of the region, and topographic characteristics of the region.

The most critical possible negative effects of mineral exploration and extraction activities on the environment are as follows: deterioration of the original morphology and aesthetic appearance of the land, deterioration of the underground and surface water balance in the region, damage to agricultural lands and forest areas, noise pollution and dust, traffic increase due to truck transportation, sedimentation of the soil and erosion, blasting and tremors caused by air shocks, formation of solid wastes in the region, air, and water pollution, and damage to flora and fauna. Again, these activities also change the socio-

economic structure of the region. On the other hand, due to the privatization of mineral exploration and extraction activities in Turkey, the mines extracted in a particular region are not for the benefit of the people living in that region but for the profit of mining companies. Moreover, the natural habitat of the local population is being destroyed.

In the EIA, to be prepared for mining activities, the region's characteristics, the effects of these activities on the environment, and their social consequences should be revealed (Keleş and Hamamcı 2005: 175–188). In addition, it is essential to reorganize and improve the lands that have deteriorated after mineral extraction activities. There is an obligation to restore the previous ecological structure of the land and further improve it. For this purpose, land use planning, reorganization, improvement, and maintenance studies should be carried out.

### 3. Features of Artvin Cerattepe

59% of the area of Artvin province consists of forest, 19% of non-cultural land, 8.2% of agricultural land, and 13.8% of meadow-pasture land; there are also tea, olive, and hazelnut gardens (TMMOB Report, 2014: 16).

The Kafkasor, the Hatila Valley, and the Coruh Valley are among the 25 most important terrestrial ecoregions in the world, the richest in terms of biodiversity, and at the same time, endangered. Moreover, the largest natural old-growth forest ecosystem in the vast geography that includes Europe and Central Asia is found here. The mine site is also the most crucial reserve and relict area of the forests belonging to the Third Time in Western Eurasia (TMMOB Report, 2014: 16).

The region is one of the rare regions on Earth where temperate deciduous forests have existed without interruption since the Third Time. The largest “natural old-growth forest” ecosystems in the vast geography of Europe and Central Asia are found here. The natural old-growth forest ecosystem is a protected forest that has not been changed by human interventions and is of particular importance in terms of providing shelter to various types of wild animals and the richness of biodiversity. Therefore, the World Wildlife Fund (WWF), which recognizes the region's importance in conservation, has declared this region's temperate zone and old natural forests as one of the “200 Ecoregions” in the world. Again, this region is located in the “Kafkasör Hot Spot”, which is one of the most important ecological regions of the world in terms of nature protection according to international organizations (Conservation International, WWF International, IUCN) (Artvin Governorship Provincial Directorate of Environment and Urbanization 2017).

For these reasons, the Hatila Valley has declared a national park in 1994. For example, dark spruce trees found in the forest in the national park area are one of the species that should be protected, which is included in the annex to the Berne Convention; Turkey became a party in 1984. Numerous protected mammal species also live in this region, which is included in the “Fauna Species under Strict Protection” Annex List II of the Berne



Convention. Many plant species and habitats in Artvin are also at risk and must be protected according to international conventions.

There are many water sources in Artvin. Especially around the mine site, there are many water sources, and the drinking water of Artvin province is provided from these sources at the same time (Özler 2016).

#### 4. Mining activities in Cerattepe

Drilling works for mineral exploration in Cerattepe, which includes the urban settlement area and the Artvin Kafkasör Tourism Protection and Development Zone and is adjacent to the Hatila Valley National Park, started in the early 1980s with the drillings of the Mineral Research and Exploration Institute (national administration authorized for mineral exploration) (In 1983, the Institute was transformed into a General Directorate under the Ministry of Energy and Natural Resources), and exploration and extraction license was obtained in 1987.

This state-owned license was transferred to a Canadian company in 1992, and this company started exploration and drilling operations this time. It was claimed that some of the villagers' cows in the region died due to mixing the chemicals used during the exploration works into the waters while the drilling works were going on. Between 1996 and 1998, official reports were published by the Artvin Governorate and Mineral Research and Exploration Institute on the problems and risks arising from the region's mineral exploration and extraction activities. In particular, according to the Decision of the Local Environmental Council published by the Governorship of Artvin (O.G. 13.02.1996/ 22553; Decision Number: 1995/4, Decision Date: 10/11/1995), the mining activities planned by the Canadian mining company will have possible environmental impacts. During mineral exploration, the company planned to build a waste dam on Gavur Creek adjacent to Hatila National Park. First of all, there will be an erosion effect. Undesirable events such as landslides, floods, etc. may occur if open pit mining is carried out or the plant and forests are destroyed due to the region's surface features, the land's high slope, and the meteorological condition of the region. Moreover, the region, especially the city center, will be adversely affected (TMMOB Report, 2014). On the one hand, the region where these mining activities are planned has a dense presence of plants and forests. On the other hand, since it is intertwined with the Kafkasör Tourist Center, it will negatively affect the tourism activities in the region. Again, as a result of mining activities to be carried out in the region, existing spring waters and surface waters in the region will be polluted. The dam to be built will also have negative effects. The area where the construction of the waste dam is planned has a border with the Hatila National Park. The storage of cyanide and other hazardous wastes in the tailings dam to be built in this region will create a high risk to the region.

In these years, to organize against these mining activities, the people of the region established the Green Artvin Association; signatures were collected through this Association, applied to the Ministry of Environment, and the Ministry took the project under review. Yeşil Artvin

Association and Artvin Bar Association filed a lawsuit against the project. As a result of the lawsuit, a decision was made to stop the execution, and the mining license was canceled in 2009. The decision of the Council of State approving the cancellation of the license states as follows (<http://www.sivilsayfalar.org/2016/02/17/cerattepenin-20-yillik-mucadelesi-anayasa-ve-mahkeme-kararlari-yok-sayiliyor/> (Last Access 29<sup>th</sup> March 2019)):

“... the mining license areas are intertwined with the national park and tourism areas, the mining operation will not have any substantial contribution to the country’s economy, the unique natural beauties and assets of the region will be damaged, Artvin is located in an area with a geological landslide risk, there are active landslide areas, there are many scientific reports on this subject, the mining activity to be carried out in the region will adversely affect plant and animal species, the activity is within the scope of the EIA regulation as of the date the licenses are issued, the licensing process is done illegally, the EIA positive report is not sought. Therefore, the operation permit and licenses should be revoked.”

Upon this decision, the Canadian company withdrew from the project; however, a new tender was made in 2012; this time, a Turkish company won the tender. An application was made to the administrative court because this tender was terminated, and mineral exploration activities were started without an EIA report. While the case related to the tender was rejected, the cancellation decision was taken in the EIA case. In the meantime, this company, which has an operating license, has announced that it will produce a copper mine using an underground operating method and that the produced mine will be transported by trucks. Later, the company applied that the gold mine located in the same area within the same license area would be produced by the open operation method. While 50,000 trees were planned to be cut down even during the underground operation, it is seen that the number of trees to be cut for such a large open operation in an area that is entirely forested is not calculated and specified in the EIA report (TMMOB Report 2014).

The Turkish Company that received the tender transferred its license to another Turkish Company in 2013. As can be seen, the mining exploration and extraction license in Cerattepe has constantly changed hands. In the meantime, lawsuits have been filed in the courts repeatedly for the positive EIA report, sometimes, these lawsuits have been rejected, and occasionally the positive EIA Decision was canceled. The company has prepared a new EIA report and received a positive EIA report from the Ministry of Environment (Cerattepe Bakır Madeni ÇED Raporu, 2015 (Cerattepe Copper Mine EIA Report, 2015).

Here, it is understood that the Ministry has taken a stance towards realizing the mineral exploration activity in question no matter what. Finally, in 2015, a lawsuit was filed for the cessation of mining activities in Cerattepe, which is described as the most significant environmental lawsuit in Turkey in which many lawyers took part.

There are different activities such as surface preparatory excavations and mining with closed galleries, processing of mines in crushing and screening facilities to be established in an open area, grinding of ore, transportation of ground ore, and storage of wastewater by transferring it to a tailings dam. Each of them has various negative environmental effects (Avcı, 2016).

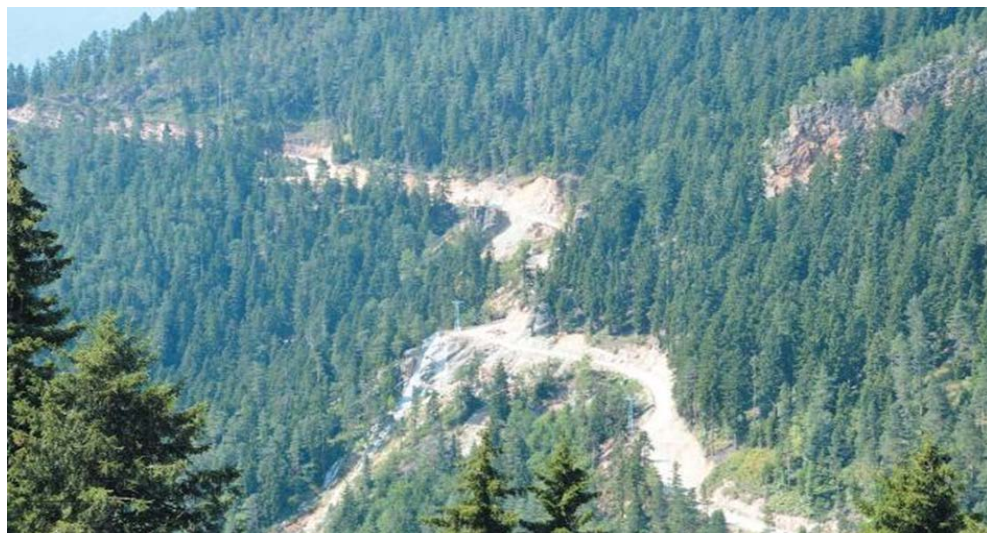
However, it is seen that the effects of these activities are not adequately reflected in the EIA report. Likewise, according to the report unanimously adopted by the Academic General Assembly of the Artvin Forestry Faculty of Kafkas University in 2006 and accepted as the “Faculty Opinion”, it was stated that the mining activity in Cerattepe is contrary to the public interest (TMMOB Report 2014).

Mineral exploration, extraction, and operation activities in Cerattepe have negative economic and social effects as well as ecologically on land use, nature protection and biological diversity, soil properties, forest areas, Artvin-Hatila Valley National Park, and Artvin Kafkasör Tourism Center in the region. The economic equivalent of all these values in Cerattepe is also in question. For example, the Kafkasör Festival is organized annually in this region, creating economic mobility and developing tourism. Traditional bullfights and karakucak wrestling are held (TMMOB Report 2014: 19). This festival also contributes to social and cultural mobility. The ecological damage caused by mining activities will harm the region’s tourism, the income from tourism will be deprived, and the traditional culture will disappear.

## 5. Conclusion

In the 168<sup>th</sup> article of the Constitution of the Republic of Turkey, “Natural wealth and resources are under the rule and savings of the State. The right to search and operate them belongs to the State. The state may transfer this right to real and legal persons for a certain time. The search and operation of natural wealth and resources are carried out by the State jointly with real and legal persons or directly by real and legal persons, depending on the explicit permission of the law. In this case, the conditions that natural and legal persons must comply with, the procedures and principles of surveillance, inspection, and sanctions to be made by the State are indicated in the law”. According to this regulation, the right to mine exploration, extraction, and operation belongs to the state; the state may transfer this right to private individuals or organizations, that is, privatize it. However, in this case, the state must determine the conditions that must be observed and supervise the activities. Privatizing mineral exploration and operating activities increases this sector’s negative social and environmental impacts. With privatization, the public sector is withdrawing from production, domestic enterprises and even foreign companies have a say in the mining sector, and these companies use underground resources.

Figure 3 clearly shows the environmental destruction of the Cerattepe region as a result of mining activities.



*Figure 3: Environmental Degradation after the Start of Mining Activities in Cerattepe.*

*Source: Green Artvin Association, 2017; <http://yesilartvindernegi.org/cerattepeyi-olduruyorlar-maden-katliama-basladi/>; (Last access: 29<sup>th</sup> September 2022).*

The fact that mines are generally located in areas with high ecological value, especially in forest areas and national parks, makes mineral exploration, extraction, and operation activities a threat to these areas that need to be protected. The activities carried out in the process of mineral exploration, extraction, and operation create a negative externality; negatively affects the air, soil, and water resources, therefore the environment and the living beings living in the environment. In fact, the problem persists even after the mining activity is over. The mine area should be closed in accordance with the rules, and the area should be restored to nature. Mining is an important sector for economic reasons such as energy needs, creating employment, and providing foreign exchange income, and this sector will inevitably continue to exist. However, mining activities need to be strictly supervised. In addition to the state audit, citizens and non-governmental organizations must follow the process and participate in the audit. One of the most effective tools for this audit is the Environmental Impact Assessment (EIA). Moreover, according to the legislation, preparing an EIA for mining activities is mandatory.

When we look at the current practices, it is seen that EIA studies are not very important in the mining sector. Because EIA studies are considered only a formality for obtaining an investment permit, it aims to obtain this permit somehow and quickly and start production.

In Artvin Cerattepe, the state's mineral exploration, extraction, and operation activities in 1980 were transferred to foreign private companies by granting licenses over time. These foreign companies withdrew as the process became problematic. With the tenders held again, the mining license was transferred to Turkish companies this time. The concerns of

the people of the region about mining activities were initially supported by reports that official institutions also drew attention to environmental risks. Because Cerattepe is a region that should be protected from an ecological point of view both for the world and for Turkey. The region should also be protected in accordance with international agreements such as BERN and CITES, of which Turkey is a party.

Therefore, mining activities' ecological and socio-economic effects on this region should be concretely demonstrated. However, a positive EIA report was prepared for the mining activity in Cerattepe, approved by the Ministry of Environment and Urbanization. Many applications have been made to the court to cancel the approval decision of the Ministry. Citizens and other non-governmental organizations, especially the Green Artvin Association, argued that the EIA report was insufficient and the ecological and socio-economic effects of mining activities in the region were not sufficiently revealed, that there were uncertainties in the report, and that these activities would harm Cerattepe. Again, the principle of participation, an essential EIA process rule, has not been complied with. Due to the EIA process, a public information meeting was desired, but it could not be held as a result of the strong reaction of the public. Despite this, decisions were made as if the process had been completed.

While the administrative courts and the Council of State had decided to stop the mineral exploration activities, the judicial decisions in the EIA process were for continuing mineral exploration, extraction, and operation activities. Mining activities continue today, with the protests and lawsuits filed by the people of the region.

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# Scenario Technique as a Method for Identifying Future Requirements for Land Management

Demonstrated by the Example of Land Consolidation in Germany

## Abstract

This paper outlines the process of building and interpreting scenarios. Using the example of the redesign in land consolidation processes in Germany, an overview of the scenario technique is provided. In addition to basic information on why and for what purposes scenarios are used, the different basic techniques for the creation of scenarios are presented. Based on this, the optimal methodological steps for the illustrated research on the redesign in land consolidation processes are derived. The case study simply illustrates the methodology and remains rudimentary in some aspects, not least due to limited space. Finally, a conclusion is given both on the use of the scenario technique as well as on the future-oriented redesign in land consolidation processes.

## 1. Introduction

Asking questions about the future is more difficult, more speculative and therefore more controversial than analysing the past (Gausemeier et al. 1996: 27). But it is clear that both, companies as well as the public sector, must look to the future if they are committed to solve the challenges that lie ahead. Increasing amounts of data, decreasing half-lives of information and faster changes in requirements are raising the uncertainty, complexity and ambiguity of getting things done. This also increases the time pressure (Ködding and Dumitrescu 2022: 120). As a result, executives focus primarily on the day-to-day business and the question: Are we doing things right? In order to identify future requirements and act for the long term, the question should be: Are we doing the right things? There are a few ways to answer this question systematically. Some issues can be well analysed using mathematical relationships based on regression or time series analysis. Relationships with multiple variables are also possible in this form (Backhaus et al. 2016: 64). Forecasts on this basis assume that no special events occur and that the relationships between the variables are stable. If a large number of variables or variables with qualitative characteristics have to be taken into account, this form is hardly usable. In these cases, the scenario technique, also known as scenario analysis or planning, is a good tool for analysing future requirements. For long-term interventions involving qualitative influences, such as those commonly used in land management, estimating future requirements is very important, e.g. the long-acting measures implemented through land consolidation.

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Since more than 100 years, land consolidation is an essential part of the German rural development policy (Schlosser 1999: 7). The requirements for the instrument have expanded over time (Schumann 2014). For example, under the initial influence of the post-war years, land consolidation policies after 1945 primarily aimed to secure food supplies and to restore rural infrastructure. In the following decades, the focus shifted to improving production and working conditions. Simplified, after the World War II, the phases of production increase, agricultural intensification, productivity increase, ecologization and adaptation to climate change were passed through (Kötter et al. 2015: 137). This change is also reflected in the requirements for the redesign of the land consolidation area.

According to § 37 German Land Consolidation Act, the land consolidation area shall be redesigned in accordance to the well-balanced legitimate interests and as required by public welfare. The law further specifies that the field mark shall be merged according to modern economical aspects and shall be redesigned suitably in terms of location, shape and size. It is characteristic for the German Land Consolidation Act that no concrete planning specifications are formulated here, so that the actual interpretation must be made by the land consolidation authority in the context of its political mandate. Thus, in addition to the purpose of land consolidation, social demands and, to a certain extent, the zeitgeist are taken into account. Due to this leeway, things were realized through land consolidation in the past, that wouldn't be done today, or that are being undone today. For example, waterways were straightened in the past, and now they are being renaturalized (Nobis et al. 2020).

When considering how long the structures created in land consolidation exist, the question arises as to whether things are being done today that will be undone in the future as requirements change. Likewise, it is questionable how a redesigned field mark should look according to modern economic aspects, as required by law. The answer has been the same for decades: Larger field-structures due to larger mechanical equipment. Whether this will still be the answer in the future decades is questionable. This is where the current research comes in that analyses the actual influence factors of redesign in land consolidation, developing and applying a methodological framework for predicting changes of the requirements, as well as presenting possible scenarios and deriving recommendations for future-oriented redesign in land consolidation.

## 2. Scenario technique basics

The use of scenarios can be traced back to Kahn and Wiener (1967). After its introduction in the defense sector, the scenario technique has been used in many fields of application and adapted to different needs, resulting in a large number of variations and combinations of scenario methods. Huss and Honton (1987) split the scenario technique methods into three main categories.

- *Intuitive Logics:* These scenarios are more qualitative and do not strongly rely on algorithms. Instead, consistent, logical scenarios are formulated intuitively in an interactive process.

- *Trend-Impact Analysis*: These scenarios are based on alternative projections of key factors that are combined using consistency algorithms to produce coherent, consistent, and plausible descriptions of the future.
- *Cross-Impact Analysis*: These scenarios are based on alternative, mostly quantitative projections of factors linked exclusively by probabilities.

According to the different methods of creating scenarios, the definitions of the term scenario also differ. Following Gausemeier et al. (1996: 90), this paper defines a scenario as a generally understandable description of a possible future situation based on a complex system of *influence factors*. In order to create such a scenario for the redesign in land consolidation processes, a combination of trend-impact and cross-impact methods is applied, since both consistency and probability are used. Even if the use of probability is controversial in the literature (e.g. Grienitz et al. 2014), at least a subjective probability should be used, as the lack of use would not lead to a better solution. Instead, available information would be ignored (Laux et al. 2018: 104).

### 3. Scenario creation

According to Gausemeier et al. (1996: 100) a scenario project runs through five phases, which are described below (see Table 1). For the current research, the phases were adapted to the special needs. The specific procedure of each phase is explained in the following chapters.

Table 1: Phases of the used Scenario Technique (Gausemeier et al. 1996: 17, Gausemeier and Plass 2014: 48)

Step	Phase	Outcome
1	Scenario Preparation	Scenario-Base – includes an assessment of the <i>decision-field</i> in its current situation.
2	Scenario Field Analysis	Key Factors – factors that are either characteristic for the development or play a major role in the determination of the <i>scenario-field</i> .
3	Scenario Prognostic	Projections – up to three possible developments for every <i>key factor</i> .
4	Scenario Creation	Scenarios – generally intelligible descriptions of a possible situation in the future.
5	Scenario Transfer	Strategies – opportunities, risks as well as scenario-based strategies for the <i>decision-field</i> .

### 3.1 Scenario preparation

Before starting the scenario building process, a working foundation is necessary. It is divided into subphases. First, it is necessary to define what a scenario project is meant to develop, i. e. what are the goals that are tried to be achieved with the scenarios. This process is always related to one specific subject of study. In the current research, this is the redesign of the land consolidation area. In order to keep the topic manageable, only procedures for the redesign of cropland and grassland areas with similar initial agricultural structures will be considered. Furthermore, it is also important to understand the extent to which the subject of study is internally controlled. This control range is called *decision-field* and should be assessed in its current situation, e.g. with a strength-weakness profile (Gausemeier and Plass 2014: 48). However, changes in requirements rarely come from the inside. For this reason, a so-called *scenario-field* is used to define an observation area that basically includes external factors that have an influence on the *decision-field* but cannot be determined by the subject of study (Gausemeier et al. 1996: 132). For the redesign in land consolidation processes the *decision-field* is e.g. the merging of plots as well as the location, shape and size of plots, ways, landscape elements and so on. The *scenario-field* are the external factors, such as societal needs, policy initiatives, technology trends, as well as private and public demands associated with the objectives of land consolidation.

Second, some practical decisions need to be made in the scenario preparation. With regard to the time horizon, it is necessary to decide whether the scenarios will be used to develop long-term or short-term visions of the future. In this context, it is also necessary to decide whether the development from the present to the future or only the future situation at a given time is required. In terms of content, a decision has to be made as to whether the future projections cover the outer limits of what is conceivable (extreme projections) or are based on what is most obvious (trend projections). Extreme in this context means overemphasized. Such overdrawn projections are intended to highlight potential trends (Gausemeier et al. 1996: 224). Finally, it must be decided who will be involved in the creation process. In principle, it is possible to have scenarios developed by one person. However, cooperative scenario development, i. e. involving several people in the creation process, offers the potential for better results (Schlake 2000: 38, Schwartz 1996: 248). To create extreme projections for the year 2050 in the case of the land consolidation research, ten experts from different disciplines, such as geodesy, agronomy and nature conservation, all working in the context of land consolidation, were involved.

### 3.2 Scenario field analysis

In this phase, the look into the future is prepared by identifying the *influence factors* that characterize the *scenario-field*. There are several methods to support this process, such as brainstorming, brainwriting or other creative methods. In a joint workshop with the experts, 32 factors influencing the redesign of the land consolidation area were identified through brainstorming and grouped by topic (see Figure 1). Each factor has to be briefly and clearly described in form of a definition.

Water management	Agriculture	Nature, Landscape, & Climate Protection	Soil	Infrastructure	Steering factors
technical flood protection	cultivated crop	preservation of grassland	land consumption	agricultural roads	land compensation of equal value
decentralized water retention	agricultural machines	biodiversity	erosion	supra-regional agricultural roads	provision of land
watercourse structure	lease relations	contracted nature conservation	soil protection	leisure infrastructure	consolidation
EU water framework directive	farms	climatic conditions	contaminated areas	energy infrastructure	
	farming method	characteristic landscape	mineral resources		
	field structure	compensation for nature			
	sprinkling	protected areas			
	resettlement farms				
	topography				

Figure 1: Influence factors for the consolidation of cropland and grassland. (Source: Authors).

Two types of analysis can be performed to determine the meaning of each factor for the *scenario-field*. One is to analyze the system behavior, the other is to analyze the relevance of the factors for the *scenario-field* (Gausemeier and Plass 2014: 51). Both analyses use a matrix as developed by Godet (1987) (see Figure 2). The direct influence between the factors is recorded in an influence matrix, which documents how much factor i (row) influences factor j (column) on a scale from 0 (no influence) to 3 (strong influence) (Götze 1993: 145). The same matrix can be filled with the question if factor i (row) is more important for the *scenario-field* than factor j (column) on a binary scale of 0 (no) or 1 (yes) (Gausemeier and Plass 2014: 53). In addition to the direct influence analysis, indirect relationships between factors can be considered as well. For this purpose, there are several algorithms, such as MICMAC (Godet 1987), Page-Rank (Gräßler et al. 2019: 140) or IIA (Schlake 2000: 165). In the presented research IIA was applied.

Influence matrix (n=10)											
Question		How strongly does the factor i (row) influence the factor j (column)?									
Rating scale		0 = no Influence 1 = low Influence 2 = medium Influence 3 = strong Influence									
Influence factor	No.	1	2	3	4	5	...	32	Active sum		
technical flood protection	1	3	2	2	2	1	...	1	27		
decentralized water retention	2	3	3	3	3	2	...	1	42		
watercourse structure	3	2	2	3	3	1	...	1	33		
EU water framework directive	4	3	3	3	3	2	...	1	46		
cultivated crop	5	0	1	1	1	3	...	3	51		
...	...	...	...	...	...	...	...	...	...		
consolidation	32	1	1	1	1	2	...	3	50		
Passive sum		26	43	31	36	53	...	46			

Figure 2: Direct influence matrix (Source : Authors based on Matrix of Godet 1987).

The sum of the rows (activity) and columns (passivity) can be visualized in a system grid (see Figure 3). The average active or passive sum divides four fields. The first field contains the very active factors having a strong influence on other factors. The passive factors are very strongly influenced, which is why changes in the system show up there most quickly and strongly. The dynamic factors are of particular interest as they have a strong influence as well as they are strongly influenced. So, they can stimulate changes in the system (Götze 1993: 148).

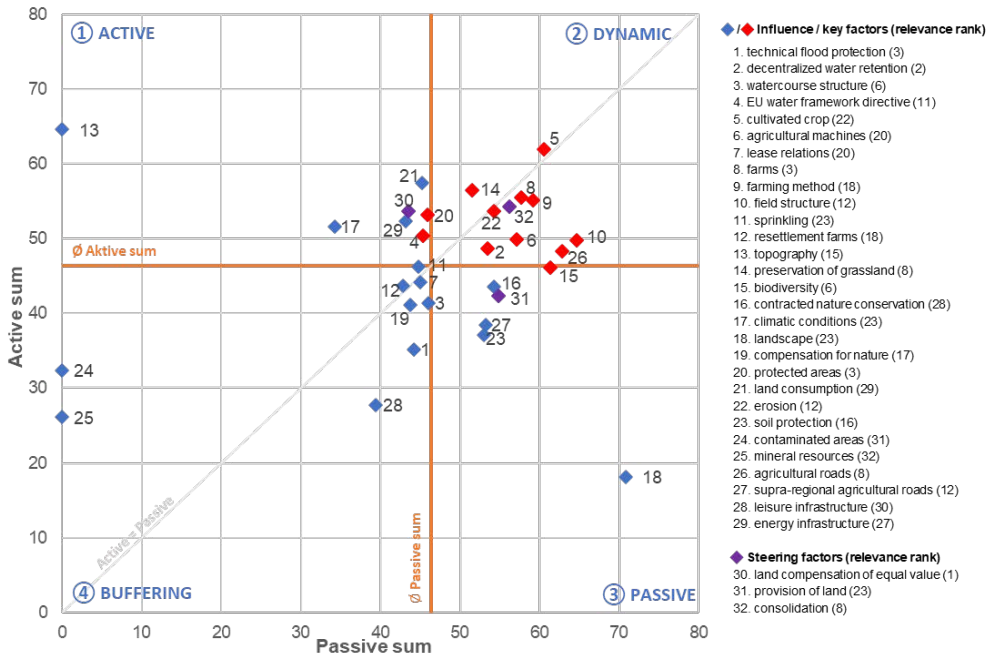


Figure 3: System grid (Source: Authors).

Using all of the identified factors to build the scenarios would make the scenarios too complex. In addition, important developments would be obscured. Therefore, a selection of the most important factors (*key factors*) for the development of the *scenario-field* must be made. (Gausemeier et al. 1996: 207). For the factors of the land consolidation of cropland and grassland, this was done in another workshop with the experts (see the 12 red icons in Figure 3). All other factors were either not dynamic or not relevant enough. The current status was then discussed and determined for each *key factor*.

### 3.3 Scenario prognostic

In the prognostic phase, the look into the future takes place. For each *key factor*, several development opportunities are identified, named and justified (see Figure 4). The aim is not only to find the most likely projection, but rather to find extreme images that can be used to fully describe the possibilities. Creating projections is a creative process, which can be

supported by quality criteria. Gausemeier et al. (1996: 226) differ five criteria. These are credibility, diversity, completeness, information content, and relevance. The projections and associated explanations for all *key factors* are listed in a *projection catalog*.

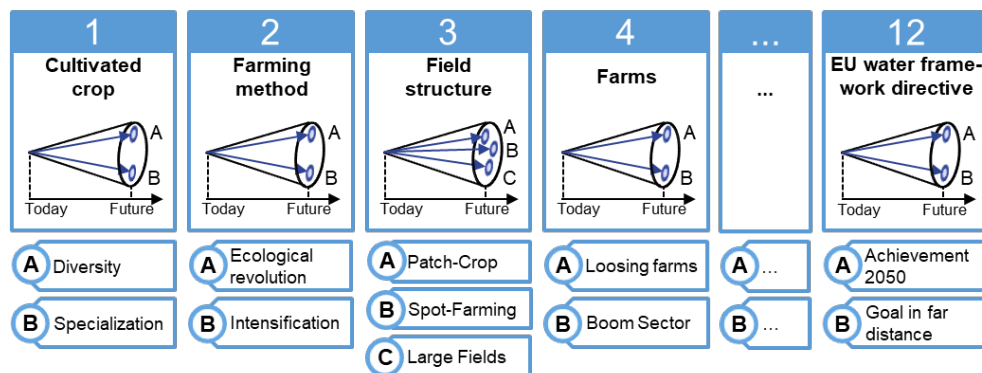


Figure 4: Key factors with projections (Source: Authors).

### 3.4 Scenario creation

The alternative development possibilities (projections) have to be combined in order to create scenarios. These combinations are called *projection bundles* and can be formed either on the basis of consistency (consistency analysis) or on the basis of probability (cross-impact analysis). In the consistency analysis, all pair combinations of projections are scored in a consistency matrix based on their compatibility (see Figure 5). The scale ranges from 1 (total inconsistency) to 5 (strong support) (Gausemeier and Plass 2014: 62).

Consistency matrix		No.	1	2	3	...	12					
Question		Projection	Diversity		Ecological revolution		Achievement 2050					
How does projection i (row) match with projection j (column)?			Specialization		Intensification							
Rating scale		Intensification		Patch-Crop		Goal in far distance						
1= total inconsistency		Patch-Crop		Spot-Farming								
2= partial inconsistency		Spot-Farming		Large Fields								
3= neutral		Large Fields		...								
4= partial support		...		...								
5= total support		...		...								
Key factor	No.	Projection	1a	1b	2a	2b	3a	3b	3c	...	12a	12b
Cultivated crop	1	Diversity	1a									
		Specialization	1b									
Farming method	2	Ecological revolution	2a	5	2							
		Intensification	2b	2	5							
Field structure	3	Patch-Crop	3a	4	2	4	2					
		Spot-Farming	3b	5	2	5	2					
		Large Fields	3c	2	5	2	5					
...	...	...	...	...	...	...	...	...	...			
EU water framework directive	12	Achievement 2050	12a	3	3	4	2	3	4	2	...	
		Goal in far distance	12b	3	3	2	4	3	3	4	...	

Figure 5: Consistency matrix (Source: Authors).

By using the scores, the consistency analysis calculates every mathematically possible projection bundle. Bundles with total inconsistency ratings (score 1) are excluded. The result is a set of contradiction-free projection bundles with a consistency score as a quality measure (Gausemeier et al. 1996: 257). The consistency analysis assumes the same probability for each projection. It does not consider the interactions between projections. Realistically, it must be assumed that the occurrence of one projection has an impact on the occurrence of another projection. These interactions are captured in a cross-impact analysis. For this purpose, the pairwise scores of the impact of the occurrence of projections  $i$  (row) on the probability of projection  $j$  (column) are collected by using the scale from -3 (significantly decreases the probability) to 3 (significantly increases the probability) and recorded in a cross-impact matrix (Götze 1993: 190). From these ratings, the probabilities (a priori) of each projection can be derived (Gierl 2000). The aim is to determine the influenced probabilities (a posteriori) of each projection, which is made by a simulation algorithm (Götze 1993: 197).

The large number of mathematically possible projection bundles can thus be reduced on the basis of the two-quality criteria consistency and plausibility. In the land consolidation scenario project, 90 projection bundles could be extracted out of 13,824. This amount still needs to be reduced to a reasonable number of scenarios that can be developed without losing the variability of the projection bundles. For this purpose, a cluster analysis is applied. First, each projection bundle is interpreted as one cluster. Then, the bundles with the greatest similarity are clustered until only one cluster is formed with combined all projection bundles. Each cluster step is associated with a loss of information, which can be visualized in a scree diagram. This shows the evolution of the partition level (information loss) as a function of the partition (number of clusters) (Backhaus et al. 2016: 494). A reasonable number of scenarios can be identified by a clear kink, as the level rises sharply to the next coarser partition (see Figure 6).

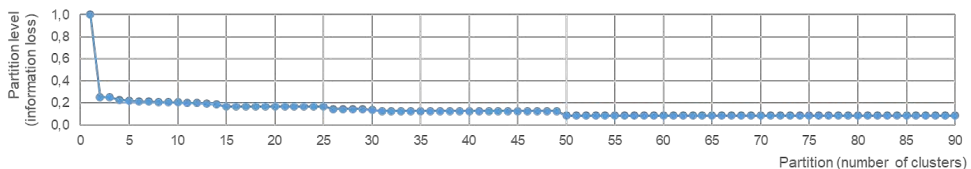


Figure 6: Scree diagram (Source: Authors).

Multidimensional scaling can be used to visualize the results of the cluster analysis (Backhaus et al. 2015: 349). Likewise, the expression of the projections within a scenario can be shown in a projection biplot (see Figure 7). The expression results from the frequency of the projection in a cluster. Alternative expressions are given if there are several projections of a *key factor* with a ratio between 25% and 75% in a cluster. Unique projections are given if one projection dominates the cluster (share > 75%) or if there is only one projection of a *key factor* with a ratio between 25% and 75% in a cluster (Gausemeier et al. 1996: 309). The scenarios are then presented in text form as a short report, describing the future situation as



vividly and easily understandable as possible. Due to space limitations, the description of the land consolidation scenarios cannot be shown here. Figure 7 shows that the two scenarios represent fundamentally different views of the future. One scenario describes a very positive development of the *key factors* (orange line), which is desired by society and politics. The other scenario represents a rather negative trend in the development of the *key factors* (blue line), toward which the *key factors* are currently moving.

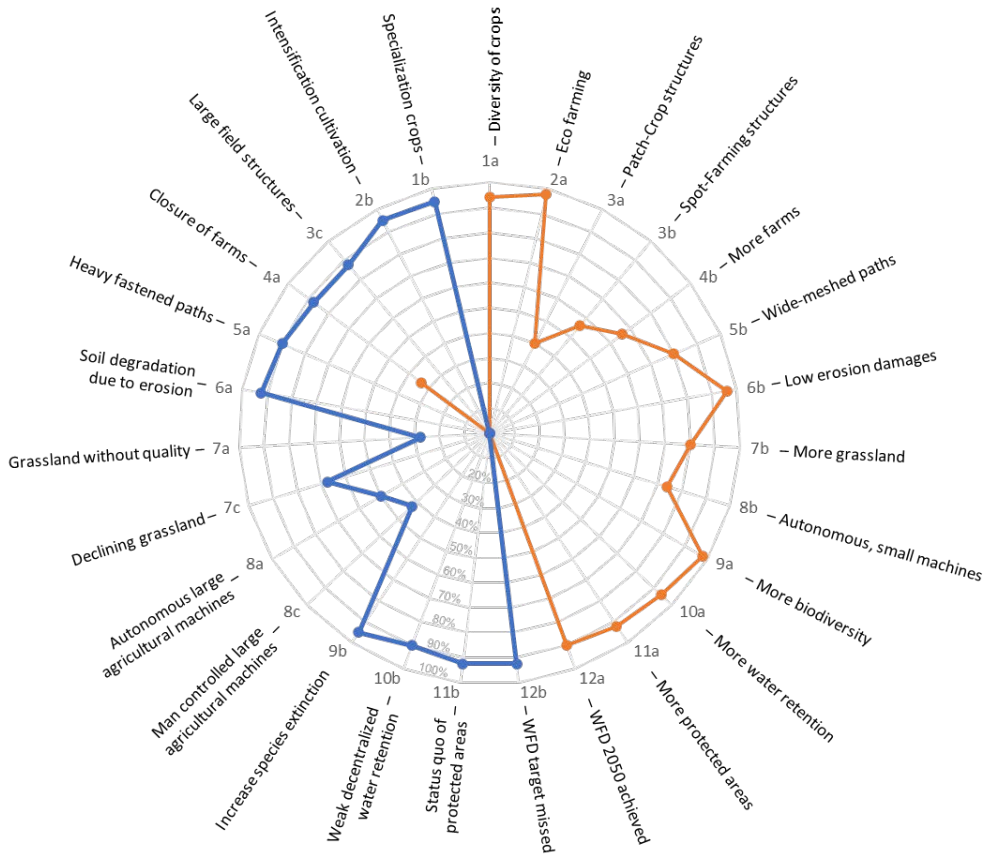


Figure 7: Visualization of two scenarios in a projection biplot (Source: Authors).

### 3.5 Scenario transfer

By thinking through future situations, it is possible to identify expected problems at an early stage and develop strategies to overcome them. In this way, the use of scenarios begins with an analysis of the impact they have on the *decision-field*, or more generally, on the subject of study. The aim of this *impact analysis* is to identify opportunities and threats in order to derive recommendations for action. An impact matrix can be used to systematically analyse the created scenarios. By rating the probability and the impact on the *decision-field*, the



opportunities and threats can be categorized. Opportunities with high probability and high impact should be used energetically, and threats should be avoided as much as possible. This requires immediate preventive planning and action. It is also important to be prepared for sudden changes. Therefore, it is necessary to develop appropriate contingency plans for high-impact, for low-probability threats, as well as for reactive plans for unexpected opportunities (Gausemeier and Plass 2014: 75). After identifying and evaluating opportunities and threats, the scenario-team must develop strategies to maximize opportunities and minimize threats. These strategies can be based on a reference scenario (focused planning) or on multiple scenarios (future robust planning). Focused strategies are powerful strategies that are easy to communicate but susceptible to external changes. Future robust strategies are flexible and open to alternative developments, but difficult to develop and communicate (Gausemeier et al. 1996: 339, 350).

Several opportunities and risks could be derived from the two scenarios for deriving a future-oriented redesign of the land consolidation areas, which can only be presented here in excerpts and in abbreviated form. In the scenario with a rather negative development of the *key factors*, for example, a strongly increasing competition for land between different land use claims is identified, which makes it considerably more difficult or impossible to provide land for public and community facilities. Due to the significant decline in farms, there is also a risk that the need for a redesign of the plots will not be given, as individual farmers will cultivate one or more districts on their own. An opportunity, for example, is a change in the focus of land consolidation to non-agricultural objectives.

In the scenario with a rather positive development of the *key factors*, a consolidation and enlargement of land for agricultural purposes, as required by law, is e.g. no longer needed, as spot-farming is carried out on much smaller plots. Likewise, the shape of the farming plots may change, as micro-robots mean that economic efficiency is no longer linked to rectangular structures. Difficulties arise, particularly in the transition phase, in which property owners or farmers are still dependent on traditional structures to improve production and working conditions. The greatest opportunity in this scenario arises from supporting this fundamental structural change in the agriculture sector as the only holistic instrument for redesigning infrastructural structures.

#### 4. Conclusion

To deal with the increasing uncertainties and to remain effective in the future, possible changes in requirements must be identified at an early stage. The scenario technique is a very powerful method for dealing with this complex planning situation. It can be used to develop scenarios that are customized to the specific context of the research topic. Based on these scenarios, strategies can be developed to maximize the potential for successful outcomes on time. Nevertheless, the extensive research and the use in various fields of application has led to a widely dispersed literature landscape of the scenario technique. An overview is provided by the articles of Tiberius et al. (2020) as well as Weimert and Römer (2021).

The case study has shown that land consolidation is well-positioned and needed as an instrument for the future. Nevertheless, there will be future changes in the general conditions to which land consolidation in Germany must be adapted. This concerns the general objectives associated with the instrument, which could have an impact on the purpose of land consolidation in Germany. There is much that indicates that land consolidation will move further away from its roots as an agricultural instrument and be more widely perceived as a general rural development instrument. Thus, the legally required improvement of production and working conditions in the agricultural sector could be pushed further into the background and other priorities, such as erosion control, nature conservation or adaptation to the consequences of climate change, could become more prominent, especially as the general environmental awareness of the population is expected to increase.

With regard to the redesign of the land consolidation area, there is an even greater potential for changes in the future. Technological developments, such as self-driving swarms of small agricultural robots, could reverse today's requirements. Instead of continually larger farming units, small and spot-farming structures will become economically viable. In addition, conventional structures no longer have to follow a regular shape, which opens up new possibilities, such as the selective exclusion of biologically valuable areas from production.

At the same time, these developments suggest that the complexity of redesign and the tasks of land consolidation will increase. It is therefore particularly important to provide sufficient and appropriate processes, to prepare the workforce for future requirements and to set long-term strategic directions.

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# Options for Spatial Action in the Context of Multi-Locality and Rural Areas

## Abstract

Multi-locality is a complex social phenomenon and a growing research topic that various disciplines are concerned with (e.g. social sciences, geography, spatial and regional planning). Particularly in rural areas, the interplay of residential presence and absence is linked to some of the most pressing challenges concerning sustainable development, including potentials and opportunities for regional development: mobility, land consumption, housing, social infrastructure, community life, tourism etc. This article contributes to recent literature on multi-local lifestyles in rural areas by examining the differences in associated potentials and challenges in four case study regions in Austria. The research followed a mixed-method approach by combining guided interviews, focus groups with multi-locals and workshops with international experts. The findings illustrate how perceptions of multi-locality vary by socio-spatial characteristics of a region and provide insight on the specific needs of multi-locals. Moreover, the paper introduces planning actions for local municipalities and regions depending on their regional characteristics.

## 1. Introduction

This paper is based on the preliminary results of an interdisciplinary research project investigating the phenomenon of multilocality in rural areas in Austria. The project was carried out between January 2022 and June 2023 and was funded by the Austrian Federal Ministry of Agriculture, Forest, Regions and Water Management (BML). The need for related research arises because ongoing trends, such as individualization (Reckwitz 2018), mobile and multi-local forms of work (Hislop and Axtell 2007; Bürgin et al. 2021) and a revived interest in rural living (Dettling 2020), contribute to the fact that the phenomenon of multi-locality becomes increasingly common in rural areas (Othengrafen et al. 2021). During the recent Covid-19 pandemic, associated health policies and distancing measures contributed to a heightened awareness for multi-local lifestyles and processes of suburbanisation (Pätzold 2021).

The political and social discussion on temporary presence and absence involves pressing questions related to mobility, reasonable land consumption, affordable housing, new

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typologies for changing residential demands, social infrastructure, community life, sustainable tourism, living and working in rural regions, etc. (Greinke and Lange 2022).

The project focused on the following research questions:

- What challenges and opportunities can be identified related to multi-locality in different rural areas in Austria?
- To what extent do municipalities and regions address multi-local lifestyles in their planning?
- How can identified strategies utilize such living and working arrangements as a resource for the sustainable development of rural areas and what are related limitations?
- What kind of planning and policy actions can be identified for different actors at local, regional and state level?

A mix of qualitative research methods was applied to study multi-local lifestyles and their spatial effects in rural regions. 10 guided interviews were carried out to engage in conversations with stakeholders at different levels of planning. Focus group discussions (15 participants) in three of the case study regions added the perspective of multi-locals. Beyond that, external expertise was integrated into the project through workshops with experts.

The aims of the research project were to determine how opportunities and challenges related to multi-local lifestyles vary across rural regions in Austria and through what kind of planning actions different actors can ensure that multi-locality works in favour of a sustainable rural development. Current strategies and solutions were analysed and limitations identified. Moreover, the project identified open questions that require further research. At the outset of this research, four case studies were conducted in different rural regions of Austria: Gesäuse, Innviertel, Lungau and Seefeld. The four regions were selected based on data of the Urban Rural Typology provided by Statistics Austria (federal institute under public law) and in a workshop with the local project partners. The data set of the Statistics Austria categorizes municipalities by demography, density, accessibility, infrastructure and economy (especially tourism).

## 2. What is multi-locality?

In the scientific discourse there is no single answer how to define multi-locality. Previous studies have highlighted several factors that make it difficult to delineate and quantitatively measure the phenomenon multi-locality:

- First, its multiple social manifestations rooted in a combination of different motives, socio-spatial practices and characteristics of places (Di Marino and Lapintie 2020), and are closely tied to individual needs and decisions (Weichhart 2020).
- Second, the lack of a statistical basis and the challenges in surveys of actual lived-in second homes (Danielczyk et al. 2020; Othengrafen et al. 2021).

- And third, multi-locality as a form of social practice causes “a virtually unmanageable network of relations, dependencies, and consequential effects”, which require inter- and transdisciplinary research approaches (Weichhart 2020, translated by the authors).

As a result, the phenomenon has received little attention in planning processes and decision-making on regional development (Lehtonen et al. 2019; Othengrafen et al. 2021).

In the German-language-scientific discourse on multi-locality, a wide variety of terms have been used to describe the phenomenon of living in more than one place (Beck 2007; Rolshoven 2006; Weichhart 2020; Hilti 2009; Neuböck et al. 2019). Put simply, multi-locality refers to living in several (multi), at least two, locations (local). The definition by Rolshoven (2006), which is often used as a starting point, introduces additional facets: “Multi-locality means *vita activa* in several places: the active everyday life in its entirety is distributed over different places, which are visited in more or less large periods of time and used with a more or less large functional participation.” (181, translated by the authors).

The classification provides a frame of orientation but raises the question what living in multiple locations specifically means. In order to delineate the studied phenomenon without neglecting the individuality of multi-local lifestyles, the authors of this paper apply the following descriptive dimensions: (1) Spatial dimension: connecting several geographic locations, (2) Temporal dimension: recurring presences and absences, and (3) Functional dimension: *vita activa*, social networks, and motives. We draw on the scientific discourse on multi-locality to build a theoretical foundation along these three criteria and to highlight the differences between our understanding and other notions of multi-locality.

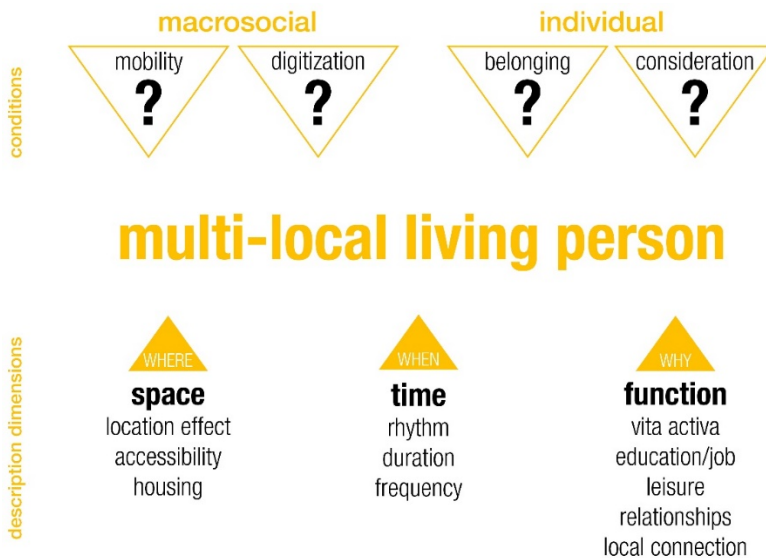


Figure 1: Dimensions of multi-locality.

Individual and macrosocial preconditions are on the top of the three dimensions of multi-locality.

On macrosocial level, increasing mobility requirements and digitization were identified as the most significant factors contributing to a rise in multi-local lifestyles in recent years. Other trends affecting certainly multi-locality include individualization, landlust, rurbanization and pluralization of lifestyles (Reckwitz 2018; Detling 2020; Neuböck et al. 2019).

On an individual level, a social connection with a place and a sense of belonging as well as individual considerations influence to what extent multi-locals return on a regular basis.

### 3. Empirical study and options for planning action

The reality of life in rural regions in Austria is increasingly characterized by temporary living arrangements. On the one hand, due to an economic restructuring, manifested in agricultural efficiency gains and a related decline in employment in industry and trade, as well as a shift to knowledge-based work and higher education (Hiess et al. 2018). On the other hand, due to changing demographics characterized by an ageing population and population decline (ÖROK 2022). Changes in the labour market and in supply structures increase the spatial mobility requirements of the local population, which affects that “personal, social and labour market networks ... extend over ever greater (spatial) distances” (Othengrafen et al. 2021, translated by the authors). Similarly, the expansion of transport infrastructure and the continuous improvement of broadband coverage facilitate the possibilities of multi-local ways of living and working (Bürgin et al. 2021). In this respect, multi-local lifestyles can be seen as an alternative to migration, which for sustainable regional development may entail both opportunities, e.g. higher activity levels, and challenges, e.g. greater land consumption and traffic volumes.



Figure 2: Selected regions for case study.



Despite Austria's relatively small geographic area when compared to the rest of Europe, its rural areas are highly diverse and characterized by different qualities and challenges. In order to acknowledge these differences and to distinguish the effects of multi-local living in specific rural areas, four case study regions were statistically analysed and spatially characterized. Guided interviews and focus group discussions were carried out in order to identify associated challenges and potential planning approaches, strategies and needs for policy actions.

### 3.1 The perspective of regional development

Multi-local lifestyles do not cause broader societal and planning policy challenges related to spatial development in rural areas, compared to demographic changes, land consumption and urban sprawl, prevailing car-dependency and high traffic volumes, public livelihood support, social inequality, supply security and climate change. However, multi-locality can reinforce these challenges, which underscores its relevance for the spatial and regional planning sciences, as well as for municipal officials, policymakers and civil society (Greinke and Lange 2022). The challenges for regional planning have only recently been analysed in a few studies particularly addressing rural areas (Danielzyk and Dittrich-Wesbuer 2020; Di Marino and Lapintie 2020; Greinke and Hilti 2019; Neuböck et al. 2019). So far, identified fields of related planning action include:

- Housing markets (regarding special housing needs and housing consumption),
- Technical infrastructures (due to high mobility and communication needs),
- Social participation (possibilities for civic engagement, citizen services, participation, etc.).

In this context, the empirical study carried out in four Austrian regions shows that municipalities and regions have so far hardly adopted measures or strategies that specifically address the needs or effects of multi-local lifestyles. This is in line with previous studies, which also identified a lack of concrete approaches for municipal officials and planning practice (Dittrich-Wesbuer 2016). When municipalities deal with this, it is primarily a matter of main or secondary residence. The background to this is that municipalities only receive money from the federal government for each main residence, but this often does not reflect the reality of people's lives. Some federal states have already implemented regulations to limit secondary residences (especially for recreational purposes).

In the study areas, municipal representatives addressed a lack of data indicating a need for action, as well as limited personnel resources. Another constraint for the municipal representatives was a lack of clarity about the link between multi-local lifestyles and the existing fields of action for regional development.

### 3.2 Challenges and opportunities of multi-locality

The case studies further show that municipal representatives and planning actors often associate the topic of multi-locality with the Austrian debate on secondary residencies, which pose a significant challenge in tourist regions (Kanonier and Schindelegger 2022), and the issue of daily and weekly commuting. For several interviewees it was the first time to discuss multi-local living in relation to other challenges, e.g. community development and civic engagement. In this context, the current empirical study confirms the findings of Dittrich-Wesbuer (2016), which indicate that the phenomenon of multi-locality and its correlation with different fields of planning require further clarification. To gain a better understanding of how potential challenges and opportunities vary between different rural regions in Austria, the study related the empirical findings to the spatial characterisation and statistical data analysis of each region. The main findings are summarized below in five fields of planning action.

#### Mobility

In peripheral rural regions, the provision of public transport presents an enormous challenge for individual communities. As transportation issues are closely tied to land use development, low-densities and a lack of mixed land use patterns challenge the provision of public transport and erode the accessibility of regions despite high levels of permanent settlements (e.g. Innviertel). In rural areas, which are characterised by high levels of tourism intensity, public transport services are often geared to the needs of tourists rather than permanent or temporary residents (e.g. Seefeld). Moreover, the findings show that there are hardly any mobility concepts that are tailored to the specific needs of multi-locally living people. Although multi-locals indicate an openness to use environmentally sustainable means of transportation, poor service provision poses a significant constraint to do so. In the analysed regions, service incompatibility concerns the location choice of temporary residents, who often frequent particularly remote areas (e.g. Gesäuse), and the scheduling of public transport, which does not meet the mobility and flexibility needs resulting from multi-local working arrangements (e.g. Lungau). Findings further indicate that poor public transport connections not only constrain the mobility options of different multi-locals, but they also can limit their ability to participate in social life, e.g. in the case of seasonal workers and caregivers.

However, the current study also shows associated opportunities. Especially in areas with low population densities and in communities affected by out-migration, incoming residents are perceived as a potential to increase the demand for underused public transport connections. Interviewees address self-organised forms of car and ride-sharing (e.g. Lungau) and voice interest in business models for e-car sharing in sprawling areas (e.g. Innviertel). In this respect, a better alignment between user needs and new mobility services as well as inter-municipal collaborations are identified as significant development opportunities.

## Housing

While the number of secondary residences decreased in alpine regions during the Covid-19 pandemic, it increased in the other rural regions of Austria (Matzenberger et al. 2021). Regional representatives mentioned in the interviews that they fear a continuous grow of housing demand and land development in rural areas. In the future perhaps also due to climate change, as climate refugees may increasingly leave cities. In tourist areas, speculative second residences have for many years put pressure on local housing markets (Kanonier and Schindelegger 2022). Apartment buildings and chalets that are purely built for investment purposes lead to vacancies and drive up housing prices. The findings of this study gives evidence that in this context municipalities are challenged to manage vested interests, which can make it difficult to discuss multi-locality unrelated to the frequently emotionalized issue of secondary residences.

In communities affected by out-migration, an influx of new people, even if only temporary, can also be positively perceived (e.g. Gesäuse). The findings indicate, that an economic restructuring and demographic decline contribute to vacancies and underutilized single- or two-family homes. Temporary residents are perceived as an opportunity to revitalize rural municipalities. While the development of new areas is negatively associated with the cost of providing additional infrastructure, the repurposing of vacant building, their utilization in off-seasons and making better use of infrastructure are addressed as positive impacts within the interviews.

## Participation

Findings show that the civic engagement of multi-locals correlates with a local community's cultural and institutional openness to newcomers, which is consistent with former research concerning participation of multi-locals in Upper Austria (Neuböck et al. 2019). This is relevant on a political level, on a public level and on an organizational level of associations and agencies. Multi-local lifestyles are particularly constrained by limited free time, which can be exacerbated by the occupational activities of certain types of multi-locals, e.g. 24-hour caregivers. Results indicate multiple ways how community services and institutional structures can adapt in order to make it easier for multi-locals to participate in community life. On the one hand, interviewees emphasise that cultural and social associations, which constitute a significant part of social infrastructure in rural communities, could benefit from enabling volunteers to participate on a seasonal basis. On the other hand, it became evident that formal and informal contact points as well as intermediaries play a significant role in promoting a welcoming culture and facilitating civic engagement (e.g. Innviertel and Gesäuse).

In rural regions with a strong industry sector, for instance, formal contact points provide social services for incoming workers in order to support their housing search and cultural integration. In rural regions that attract multi-locally living knowledge workers, multifunctional spaces combining coworking and cultural events can create the necessary

environment for informal exchange and social onboarding. In this sense, the findings of this study are consistent with previous studies emphasising the positive influence of coworking spaces on workers' well-being (Merrell et al. 2022). These examples highlight the potential of fostering social infrastructure and services, which cater to the varying needs of specific groups of multi-locals through distinct formats and means of communication.

### Infrastructure

As municipal budgets are shrinking and the requirements for public infrastructure are increasing, the provision and maintenance of affordable infrastructure and services is perceived as a considerable challenge in the case study regions. In tourist regions particularly, seasonal fluctuations in infrastructure utilization and service demand pose a significant challenge for municipal financing (Bender et al. 2005). The temporary presence and absence of multi-locals can exacerbate the issue, as they contribute to an over- and underutilization of technical infrastructure (e.g. Seefeld). At the same time, multi-locals can contribute to the stabilization of touristic and cultural offers as well as public services, which represents an opportunity for municipalities and regions (Lehtonen et al. 2019).

Although multi-locals do not necessarily require additional infrastructure (Greinke and Lange 2022: 72), this study shows that specific needs of multi-locals reinforce issues relevant to society as a whole. For instance, the need for childcare arrangements that cater to seasonal workers highlight the oftentimes insufficient provision of childcare in rural regions. Moreover, a lack of high-performance internet connections is perceived as a significant disadvantage in rural regions, which affects the ability of permanent residents as well as multi-locals to work remotely and access public information or services (e.g. Gesäuse and Innviertel). While insufficient broadband coverage inhibits multi-local work arrangements that rely on digital technologies (Bürgin et al. 2021), it has far greater effects on rural communities as a whole. Particularly, since digital solutions are frequently perceived as a possible means to complement and enhance traditional service infrastructure despite constrained municipal finances. The lack of resources in rural regions emphasises the need for creative and innovative strategies, which are often facilitated through digital infrastructure and media.

### Work

Deregulation and flexibilization trends in the labour market contribute to a rise in short-term employments and frequent changes in work arrangements, which may lead to relocations (Tippel 2020: 93) and new working practices (Di Marino et al. 2018). Moreover, economic and societal restructuring processes affect employment locations and the spatial distribution of job opportunities. In this context, work-related multi-locality can be a voluntary strategy and lifestyle choice, e.g. knowledge workers who choose to regularly change their working environment and intentionally seek scenic locations in the periphery (Bürgin et al. 2021), but it is more often a necessity. Particularly in rural regions, multi-local

working arrangements are affected by a scarcity of employment opportunities as well as skilled workers (e.g. Lungau).

Study results point towards some of the challenges and opportunities that are associated with flexible and multi-local work arrangements. Particularly in touristic and industrial regions, multi-local workers are perceived as a critical labour force that regional economies rely on (e.g. Innviertel). This confirms previous findings in the literature that incoming residents can provide an opportunity for regions to curb the shortage of skilled workers, even if jobs are only temporarily filled (Greinke and Hilti 2019). In this sense, it is significant that municipalities forge strategies that enhance multi-local working and living arrangements.

At the same time, the study gives evidence that flexible work arrangements enable students and knowledge workers, who previously left rural regions for educational or job-related opportunities, to return (e.g. Gesäuse and Innviertel). While digital connectivity accelerates a shift in working practice towards remote work in the creative and knowledge-based industries (Bürgin et al. 2021), in the case study rural regions doing so is still a challenge. Inadequate office spaces, insufficient broadband coverage and a lack of social contacts with colleagues are addressed as drawbacks. Improving the working conditions for knowledge-workers in rural regions may thus pose another development opportunity. If well integrated, the presence of multi-locals is associated with positive effects of a brain gain and therefore as a contributing factor for the sustainable development in rural regions (Greinke et al. 2021).

#### 4. Conclusion

The term multi-locality is not based on a uniform definition and is difficult to delineate. In planning practice, the phenomenon of multi-locality has hardly been addressed and is associated, if at all, with the issue of secondary residencies, which tends to have a negative connotation in regions affected by high levels of tourism intensity. Due to the multifaceted nature of the term and a lack of statistical data on how many people live multi-locally, municipalities and regions do not yet account for the recurring presence and absence of multi-locals. At the same time, the trend of living and working in multiple locations has strongly grown in recent years. The results of the empirical research conducted in four rural regions in Austria substantiate previous findings (Lehtonen et al. 2019; Othengrafen et al. 2021; Dittrich-Wesbuer 2016) in emphasising that planning actors need to better utilize the benefits of multi-local lifestyles and avert possible negative effects (for instance, increasing costs for housing, high levels of traffic or varying utilization of infrastructure).

Engaging with the subject of multi-locality allows a focused debate on urgent questions concerning the future of and life in rural areas. In many cases, multi-locals have specific needs, e.g. regarding mobility and housing, and raise some challenging questions, e.g. who can or is allowed to participate in what way. If multi-locals are well integrated, municipalities and regions as a whole and ultimately the local population may benefit from new planning strategies and subsequent regional development.

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# Neighbourhood-Specific Aspects for a Sustainable Mobility Transition

Findings from the research project PaEGIE<sup>1</sup>

## Abstract

The transportation sector is a major contributor to greenhouse gas emissions in Germany. In order to achieve the climate goals, a transition to sustainable mobility is needed. This transition requires a fundamental change in mobility behaviour. As mobility needs vary among individuals and neighbourhoods, a differentiated approach is necessary. Social acceptance plays a crucial role in the mobility transition. Therefore, participatory elements are needed to increase the legitimacy of decision-making processes. The PaEGIE research project, funded by the German Federal Ministry of Economic Affairs and Climate Action (BMWK), investigates how participation, supported by an interactive WebGIS application, can lead to greater acceptance and behavioural change in the mobility transition. Based on the research project, this article explores the different attitudes and demands of residents in different neighbourhoods and tests the hypothesis that a neighbourhood-specific approach to mobility planning is necessary.

## 1. Introduction

In Germany, a large number of trips are made by private motorized transport, most of which relies on conventional fuels, e.g. diesel or gasoline (Nobis and Kuhnimhof 2018, p. 52–53). This has a negative impact on the environment in the form of emissions. The transport sector accounts for around 20% of greenhouse gas emissions in Germany, making it the third-largest polluter behind the energy sector and industry (Federal Government of Germany 2019, p. 232). In order to meet international as well as national climate targets, there is therefore a great need for action in the area of mobility and transport. Restricting only the volume of traffic does not achieve this goal, because mobility is a basic human need (Hefter and Stier 2016, p. 83), the fulfilment of which is always accompanied by the use of means of transport. The transition to sustainable mobility (mobility transition) must include not only a change in the use of means of transport (traffic transition) and changes in the provision of fuel (propulsion transition) (Manderscheid 2020, p. 38), but also a change in the behaviour of society, which includes a reduction in the volume of traffic as well as a modal shift. This illustrates the particular challenge of the energy transformation in the area of transport and mobility: Its success requires not only technical and infrastructural

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<sup>1</sup> Participative Energy Transformation: Innovative Digital Tools for the Social Dimension of the Energy Transition

innovations, but also a fundamental change in mobility behaviour and a corresponding acceptance by citizens.

Since social acceptance plays a decisive role in mobility transition, participatory elements are required. Participation means involvement in political-public affairs and includes voluntary actions that affect the formation of opinions, wills and decisions (Niedermayer 2005, p. 192; Kaase and Marsh 1979, p. 42). Within a democratic system, participation serves to increase the legitimacy of decision-making processes (Scharpf 1999, p. 17; Geißel 2008, p. 24 ff) and thus to justify and successfully implement mobility projects, for example. The PaEGIE (Participatory Energy Transformation) project, funded by the German Federal Ministry of Economic Affairs and Climate Action (BMWK), investigates how new digital participation forms and processes in the energy transformation in the field of mobility and transport can achieve greater acceptance and a fundamental change in the behaviour of citizens.

When it comes to changing behaviour, it is important to emphasize that this is a very individual process for each person because of their initial attitudes toward mobility and their different needs. Families with children may have different needs than a single person. Residents who live far from a city centre may need different means of transportation than someone who lives close to the centre. Also, elderly people may have different mobility needs in terms of destinations and times than an employee. These examples indicate that there is no perfect mobility concept for all inhabitants of a city and that a differentiated approach is necessary.

The term segregation describes the unequal distribution of population groups with certain socio-demographic characteristics, e.g. income and education level but also cultural characteristics across neighbourhoods or other spatial levels. (Farwick 2012, p. 381) With the different needs of different population groups described above, this can lead to entire neighbourhoods tending to have different mobility behaviour than other neighbourhoods in the same city. Therefore, mobility planning also requires a close look at the inhabitants of different city districts.

It is important to note that there could be different approaches to mobility changes for specific groups of people, e.g. differentiated by age, by gender or by household size, based on their personal attitudes and needs. Key aspects of this study are to investigate the different attitudes and demands of residents in different neighbourhoods with the hypothesis that these differences are significant enough to require a neighbourhood-specific approach to mobility planning as well as to verify this hypothesis.

## 2. Methodology

As part of the PaEGIE project, three example neighbourhoods in the city of Darmstadt were studied in order to design the mobility transition locally, considering different initial situations in terms of infrastructure and population composition. The neighbourhoods – Mollerstadt, Lincolnsiedlung and Heimstättensiedlung (see Figure 1) – were chosen based

on their location, building development and population (Stahl et al. 2021, p. 8–14). The initial situation was objectively recorded by an inventory and then supplemented by subjective factors obtained by a citizen survey. The participation tool developed in the project was used in neighbourhood-specific citizen workshops and tested with regard to its suitability for the local design of mobility.

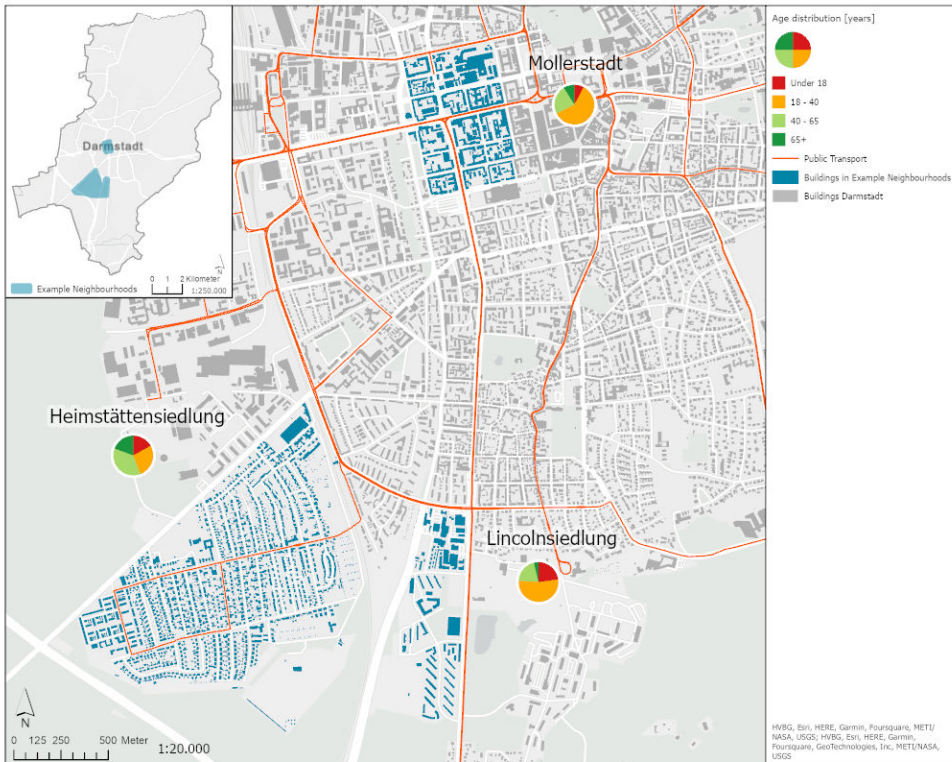


Figure 1: Example neighbourhoods in Darmstadt (Source: Own Figure).

## 2.1 Inventory

As part of the inventory of the relevant settlement and transport infrastructure, a literature review was conducted with the aim of collecting available and current information on the inhabitants of the study areas as well as on existing mobility services and concepts. The statistical data report of the city of Darmstadt as well as published framework plans, traffic studies, neighbourhood and mobility concepts were included. In addition, geospatial data of various facilities and services, such as public transport stops, car and bike sharing stations were analysed. These data were mainly obtained from the Darmstadt City Atlas and the real estate cadastre. Site visits were carried out in the three neighbourhoods to confirm the researched data and to complete missing data.

## 2.2 Citizen Survey

In order to capture attitudes and mobility behaviour that are individually dependent on the resident citizens, a citizen survey was conducted in 2021. The residents of the three neighbourhoods received a postal letter with an individual and unique access code based on a random sample drawn from the municipal registration office. Participation was possible via an Internet link, a QR code or by telephone. The questionnaire included personal information, general questions about life in the neighbourhood, individual availability and use of different means of transport, basic attitudes toward the energy and mobility transition, interest in participation and especially digital participation formats. The results of the survey were considered in the development of options and simulations for the following citizen workshops.

## 2.3 Citizen Workshops

To engage in dialog with citizens, neighbourhood-specific workshops were held that focused on local concerns and generated local knowledge. The participation process was designed by using visual instruments. The interactive use of the visualizations was achieved through web applications. A spatially experienceable representation of the city in the form of digital 3D visualization applications enables a realistic representation of planning projects. The tool allows the input of point and line elements that need to be thematically embedded and can be placed in the spatial environment. In the context of mobility, two basic use cases have been developed. One is an analysis tool for citizens to make them aware of their own mobility behaviour. By indicating routes as line elements, the user receives results of a mobility analysis e.g. produced CO<sub>2</sub> emissions for different means of transport. The other is the placement of existing and proposed mobility infrastructures, such as charging stations or sharing offers, which can be placed as point elements. Entered elements can be viewed, evaluated and commented. In this way, the current situation as well as new planning ideas can be illustrated and planning projects can be virtually tested and discussed.

### Citizen Workshops I

The first citizen workshops served as a pilot phase to test the developed digital tool in the context of a workshop. The topic of the workshops was rather abstract and resembled an extended inventory with spatial location of information. The content objective was to exchange knowledge and to create awareness regarding the need of mobility transition and the options in the neighbourhood areas. The workshop was held in May 2022, in each example neighbourhood separately. Along with an input talk and a final discussion, the main part of the workshops consisted of three units with different focal points: Unit 1 addressed the topic of electromobility by thematizing public charging stations. Unit 2 dealt with individual mobility behaviour, and unit 3 focused on shared mobility offers like public transport, car sharing, bike sharing and cargo bike rental.

When useful, the units had digital parts, using the participation tool on a multitouch table (see Figure 2). The participants could work together and discuss with their fellow citizens.



*Figure 2: Participant using the participation tool on a multitouch table  
(Source: Gerd Keim).*

### Citizen Workshop II

After the first workshops, the participation process and the tool were evaluated and further developed. In cooperation with the city of Darmstadt, a concrete participation topic was elaborated in order to test the participation tool in a second citizen workshop with increased practical relevance. For the participation tool, the use cases were further developed according to feedback from the citizens of the first workshops and the new context of content.

The second citizen workshop took place in November 2022. In an online workshop, the mobile future of the city of Darmstadt was discussed with the citizens of the example neighbourhoods. The topic of the workshop was micro mobility<sup>2</sup> options and their sharing offers. In addition to citizens, experts from the mobility planning department of the city of Darmstadt were involved in order to enable an effective deliberative process.

After an input lecture and an introduction about the use of the participation tool, solution approaches and measures for sustainable mobility were developed and discussed in three neighbourhood-specific group rooms (breakout-rooms) through the individual and simultaneously interactive use of the participation tool. The application of the tool was carried out in two parts. The first part focused on routes on which micro mobility offers are used or could be used in the future. In the second part, concrete locations were proposed for borrowing and parking micro mobility sharing offers. In both cases, the participants first draw individually routes or locations, and afterwards they jointly discussed and debated the published results in the neighbourhood group. At the end of these processes, key recommendations for the three respective neighbourhoods were developed and recorded in written form.

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<sup>2</sup> According to the authors' understanding, micro mobility comprises the mobility forms bicycle, e-bike, e-scooter, (e-) cargo bike and e-moped.

### 3. Results – Participation Process

#### 3.1 Inventory

In the context of the inventory, the special characteristics of the example neighbourhoods is highlighted. A comparison of the socio-demographic conditions is provided in Figure 3 and described in the following.

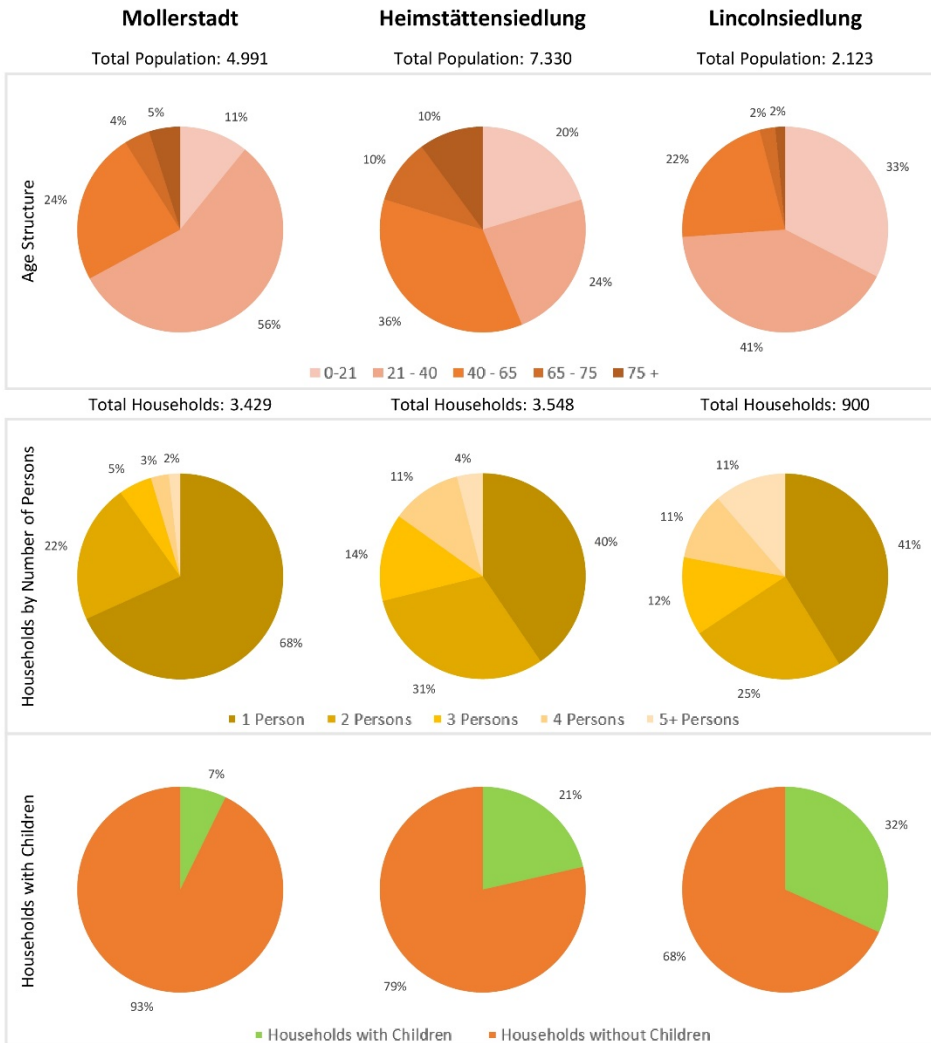


Figure 3: Statistical data of the example neighbourhoods (Data source: Wissenschaftsstadt Darmstadt 2022).



Mollerstadt is a downtown district with dense perimeter block development, high density of uses and very frequent public transportation connections. It has a high proportion of single-person households (68%) and people of working age<sup>3</sup> (84%) (Wissenschaftsstadt Darmstadt 2022).

Heimstättensiedlung is a neighbourhood on the outskirts with many single-family home lots and some redensifications at the edges. It has a high proportion of multi-person households (59%) and households with children (21%) (Wissenschaftsstadt Darmstadt 2022). The residents tend to be older, many people are over the age of 65 (20%) (Wissenschaftsstadt Darmstadt 2022). At the beginning of the project, there was only one bus line connecting it to the city centre.

Lincolnsiedlung is a new residential quarter with multi-family houses on the southern edge of the city on a former housing estate for American forces. Its residents tend to be young<sup>4</sup> (33%) with a high proportion of people with an immigrant background (45%) (Wissenschaftsstadt Darmstadt 2022). It has a high streetcar frequency into the city centre and was developed as a multimodal and car-reduced residential neighbourhood with the aim of decoupling housing and parking. A local mobility consulting and exclusive mobility offers, such as e-car sharing and cargo bike rental, are present.

A total of 469 citizens responded to the survey (response rate = 9.4%). The survey results were analysed descriptively (Lortz et al. 2021).

When asked about their attitudes toward the mobility transition, 52% of participants from Mollerstadt, 38% of participants from Heimstättensiedlung, and 52% of participants from Lincolnsiedlung said they fully supported it. In Mollerstadt, 36% of respondents fully supported the statement of accepting changes for the mobility shift, 21% in Heimstättensiedlung and 27% in Lincolnsiedlung. 58% of the participants from Mollerstadt, 42% of the participants from Heimstättensiedlung and 55% of the participants from Lincolnsiedlung fully agreed with the necessity of the mobility shift for climate protection.

The participants from the three neighbourhoods also differed in their use of transportation: While only 5% in Heimstättensiedlung use public transportation (almost) daily, 29% in Mollerstadt and 26% in Lincolnsiedlung do so. Sharing services are used particularly in Lincolnsiedlung (Occasional use<sup>5</sup> of: E-Scooter (15%), Car sharing (29%), Bike sharing (23%)), a little less in Mollerstadt, but (almost) never in Heimstättensiedlung (sharing services are used by less than 7% of participants occasionally). The car is used (almost) daily by 35% of participants in Heimstättensiedlung, compared to only 21% in the other two neighbourhoods. Bicycles are used (almost) daily by 45% of participants in both, the Heimstättensiedlung and Lincolnsiedlung neighbourhoods, and by 30% of those in the

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<sup>3</sup> Based on available data: age between 18 and 65

<sup>4</sup> Based on available date: age up to 21 years

<sup>5</sup> Occasional here includes uses ranging from “less frequently than monthly” to “1–3 times a week.”

Mollerstadt neighbourhood, which is in the central part of the city. Unlike the other two neighbourhoods, many destinations there are within walking distance.

### 3.2 Citizen Workshops

#### Citizen Workshop I

The first citizen workshops were attended by five participants from Lincolnsiedlung, eight participants from Mollerstadt and seven participants from Heimstättensiedlung.

The results of unit 1 documented which e-charging stations are known and used by the participants, given that the participants own an electric car, which was only the case in Heimstättensiedlung. While the participants of Mollerstadt hardly knew the stations in their neighbourhood, the awareness of the stations in Heimstättensiedlung was much higher.

During unit 2, each of the participants filled out their own mobility map. Looking at the choice of transport mode in relation to the destination, participants of all neighbourhoods gave priority to cycling, regardless of destination. In Mollerstadt, participants chose public transport slightly more often, and in Heimstättensiedlung, they chose the car slightly more often. In Lincolnsiedlung in particular, participants walked many routes.

Unit 3 addressed the awareness and use of shared mobility offers. As one example, the car sharing stations were known to the majority of the participants. When comparing the neighbourhoods, the degree of use is lowest in Mollerstadt. The discussion with the participants revealed that the participants used car sharing mainly for long distances, for trips to destinations difficult to reach by public transport, and for the purpose of transport of goods, e.g. when shopping or moving. When participants didn't use car sharing, it was because they did not need a sharing car (e.g. they generally do not use a car or they have their own car (esp. in Heimstättensiedlung)), because a shortage of car sharing cars, or because of costs.

#### Citizen Workshop II

A total of eight citizens participated in the digital workshop, four of them residents of Mollerstadt and four residents of Heimstättensiedlung. Despite some advance registrations, no participants from Lincolnsiedlung attended Workshop II.

In the first part of the workshop, the participants drew frequently used routes into the tool, received a mobility analysis for these routes, and discussed the routes. In the second part, an analysis of the micro mobility offers was made. The neighbourhoods differed particularly with regard to the existing offer and the resulting requests of the participants: While in Mollerstadt the offer of sharing stations is already quite high, the offer in Heimstättensiedlung is low. In Heimstättensiedlung, the participants basically wanted a comprehensive network of stations, while in Mollerstadt, the aim was rather to increase the number of individual vehicles.

Both neighbourhoods proposed the implementation of an online application that would aggregate all sharing offers reducing the variety of different applications. Apart from that, the proposals of each neighborhood differed: While an improved offer of cargo bike sharing and bike lane safety were priority in Mollerstadt, in Heimstättensiedlung lower costs and the transfer of services to the public sector were proposed options.

## 4. Discussion

### 4.1 Inventory

The inventory clearly shows the differences between the neighbourhoods in terms of location in the urban area, population structure and existing mobility services. While Mollerstadt is a central inner-city neighbourhood, Lincolnsiedlung and Heimstättensiedlung are located on the outskirts of the city. The distance to the city centre could have an influence on mobility behaviour. The residents of Mollerstadt tend to be young and live alone, while Heimstättensiedlung is home to more older people and families. Different life situations could have an impact on mobility needs and behaviour. Lincolnsiedlung is characterized by a special mobility concept. In addition to the socio-demographic aspects studied, these circumstances could lead to more people settling in the Lincolnsiedlung for whom mobility is a high priority, which could also be reflected in their attitudes in the area of mobility and their mobility behaviour.

### 4.2 Citizen Survey

A key aspect in conducting online surveys is the accessibility of the target population. The response rate to the citizen survey was 9.4% and is considered normal for an online survey. By addressing citizens by letter to participate in a voluntary survey, it can always be assumed that mainly people who are interested in or polarized by the topic will participate. This means that a certain bias is to be expected. Furthermore, Internet users are younger than the average for the population as a whole, tend to be male, have a higher income and a higher level of education (Wagner-Schelewsky und Hering 2019, p. 790). For the current project, this can be confirmed with the participants of the survey (median age group = 25 – 34 years, male participants = 55%, > 60% have a net income above 2000 € (median income in Germany 2019: 2003 € (Socio-Economic Panel 2022)), 37% with a master degree) and should be considered when drawing conclusions about the neighbourhood as a whole. However, this bias is likely to occur evenly across all neighbourhoods studied, so that the comparability between the neighbourhoods is given.

Regarding the respondents' attitudes toward the mobility transition, the approval rates are generally remarkably high, indicating the interest bias. However, the residents of Heimstättensiedlung were more cautious than the respondents in the other two neighbourhoods. This could be due to the comparatively high affinity to cars in Heimstättensiedlung, which is reflected in the significantly higher car use rate. New mobility offers, such as car sharing, bike sharing or e-scooters, played a rather minor role in all neighbourhoods. There may be

potential for increasing awareness in these offerings. The respondents tend to be neutral about these newer services in particular, although they could make a major contribution to the mobility transition. In Lincolnsiedlung in particular, the use of sharing services is higher than in the other neighbourhoods. This is probably due to the great variety and density of services as well as the assumed settling of people interested in the mobility transition.

#### 4.3 Citizen Workshops

Attendance at a workshop will certainly depend on a number of factors, such as time and place, as well as format (face-to-face or online). Announcing a new form of participation through a digital participation format not only has the potential to attract participants, but also the risk of putting off less tech-savvy people. However, participants in the citizen workshops showed great interest and were not afraid to use the multitouch table or the online tool, regardless of age.

As there were no more than 10 participants in each citizen workshop, the results regarding the contents are not representative. In addition, the workshop participants belonged to a certain group of people that did not reflect the population of the example neighbourhoods compared to the results of the previously conducted citizen survey and to statistical data. Therefore, the results achieved with regard to mobility planning cannot be regarded as representative for the neighbourhoods. However, the small size of the group enabled an intensive exchange with the participants, resulting in constructive suggestions for improving mobility in the neighbourhood as well as for the further development of the participation tool.

As the evaluation of the workshops was carried out for each neighbourhood individually, a comparison is possible. Thus, different needs and priorities became obvious, e.g. regarding e-mobility or micro mobility offers. Mobility needs naturally extend beyond the boundaries of the neighbourhood, but nevertheless, many trips begin and end in one's own neighbourhood, or the residents of a neighbourhood frequently use similar routes. In this respect, an individual look at the various neighbourhoods is worthwhile in order to generate local knowledge and to integrate it into planning considerations. The clearer the reference area, the easier it is to communicate in the group due to a precise knowledge of the location. Furthermore, a stronger identification with the reference area is possible in this way.

### 5. Conclusion

Mobility is determined by a large number of influencing factors that interact in complex ways and therefore cannot be strictly separated from each other. These factors include social and economic conditions, individual life situations, individual attitudes and orientations, settlement structures and accessible mobility offers. (Hunecke and Schweer 2006, p. 148) Clearly, these can vary locally.

Within the PaEGIE research project, different framework conditions, different mobility behaviour, different needs and priorities could be perceived in the example neighbourhoods

considered. Since change of behaviour in the context of the mobility transition is only possible when supported by the citizens, it is advisable to meet citizens locally and to develop concrete ideas in cooperation with them, which on the one hand create incentives to change mobility behaviour, and which on the other hand should be adapted to the neighbourhood so that they are also accepted.

Focusing on individual neighbourhoods of a city provides a sound basis for planning decisions, since a purely city-wide approach and an attempt to make general statements for the city as a whole do not reflect the actual situation in all areas of a city. Therefore, in addition to an overall approach to mobility at the city level, the individual situation and needs of the residents of individual neighbourhoods should be included in planning. Local knowledge is very valuable for planning, but it can be very time-consuming to obtain.

The study confirms the hypothesis that neighbourhoods can differ significantly in their attitudes toward the mobility transition. Therefore, a neighbourhood-specific approach is recommended for the implementation of instruments for managing the mobility transition.

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# Interdependencies in Spatial Planning and Well-being in Rural Areas

## Abstract

Understanding the complex interdependencies between spatial planning decisions and demographics on the one side and infrastructure and well-being on the other, is of great relevance for ecological, social and spatial justice and sustainability in rural areas. For example, building a new retirement home may result in fewer travel times or costs for relatives. However, it may also attract older people from surrounding areas, which could affect the demographic situation there and lead to underutilization of single-family houses. Ignoring the interdependencies may also result in new single-family housing areas by attracting residents from the surrounding existing single-family housing areas. Main goal of the current project is the conception and implementation of a model for verifying interactions between demographics and spatial planning decisions as well as between well-being and the various influencing factors, such as supply infrastructures. The focus is on single-family housing areas in rural regions of Germany, which have a correspondingly low resilience to demographic changes due to their homogeneous age structure.

## 1. Introduction

The presented approach aims to create a model for the investigation and visualization of interdependencies, in particular between supply facilities, demographics, settlement structures and individual well-being in rural areas of Germany. Its goal is to incorporate the heterogeneous fine-grained data sources and to implement the relations between the individual influencing factors. Therefore, the use of a knowledge graph as a method to handle these data is discussed.

Strategic planning decisions, e.g. the construction of a retirement home or the designation of new building areas, are linked to demographic processes. The resulting interactions are sometimes complex and are not always considered in the planning process. For instance, constructing a retirement home may cause older people to move away from the surrounding region's ageing single-family home areas (SFHA). In Germany, approaches focusing on the relevant interdependencies are missing, especially in rural areas. Adam et al. (2018) see the relevance of the ageing SFHA for municipalities justified by a concentrated occurrence of vacancy when 1/ public infrastructures can only operate with huge deficits, 2/ problematic

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social structures arise, 3/ a selling wave reduces the value of the homestead as a retirement savings. They consider the issue of “older single-family homes in transition” as not in the focus of current public, political and planning discussions. Instead, the attention is set on new residential constructions. Against the background of an increasing need for living space and sustainable urban development, as well as the avoidance of new land consumption, they promote a stronger focus on the development of existing buildings rather than the designation of new building areas (Adam et al. 2018).

Considering the various interdependencies between demographics, well-being or quality of life and spatial planning is essential and also complex. This complexity of possible interdependencies also leads to a high complexity of the relevant data. Datasets differ in general availability, privacy restrictions, license, granularity, reference systems and more. The focus of the approach discussed here is on demographic processes, in particular migration processes for rural areas in Germany, which poses additional challenges to the analysis, e.g. few data.

Findlay et al. (2015) propose a perspective on human migration that links the geographical decision to migrate (where) with the life-course (why) (Findlay et al. 2015). Figure 1 shows an example of a life course at different places.



Figure 1: Example Life course, own contribution according to Findlay et al. (2015).

Findlay et al. mention that migrations are time-dependent, e.g., when an economic recession lowers the migration rates in different cohorts. Stawarz et al. (2022) analysed the impact of the COVID-19 pandemic on internal migration in Germany. Using data from the population registers of German municipalities on annual flows between 401 counties, they found that the COVID - 19 pandemic was associated with a 5% year-on-year decline in the intensity of inter - county migration in 2020 with the highest decline (7–8%) of the young adults (18–29 years). As key drivers they identified fewer rural–urban moves among young adults, coupled with continuing urban–rural moves among the age groups  $\leq 17$ , 30–49 and  $\geq 50$  years (Stawarz et al. 2022).

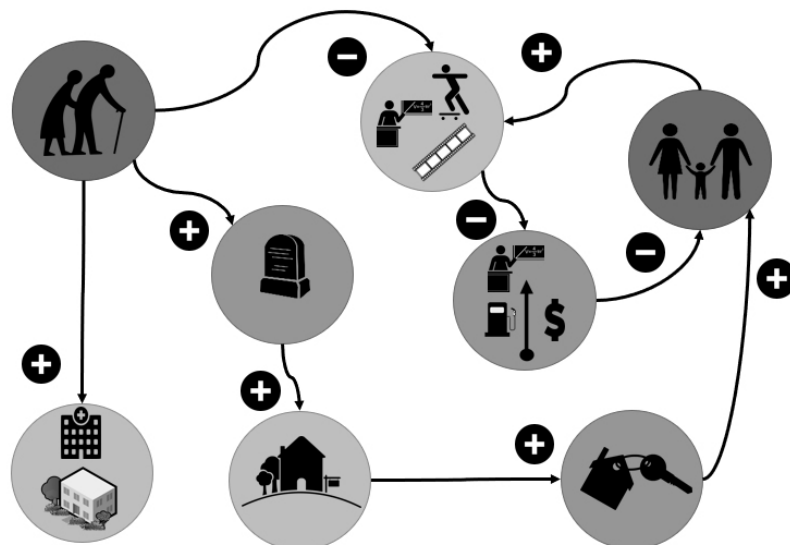


Figure 2: Example Causal Loop, own contribution according to Flach (2012).

Figure 2 represents an example of a causal loop visualization related to possible interdependencies of the demographic process of Figure 1. It is derived from an example given by Flach (Flach 2012). He explicates that an ageing population can lead to an increase of the demand for infrastructure types especially relevant to older people, like hospitals, geriatric care or retirement homes. However, it can also result in a decreasing demand in general and in particular for infrastructure types, like kindergarten, schools or other institution with a strong focus on young users. A lower utilization rate results in higher costs, the limitation of uptimes or even the closing of facilities. In the education sector, declining student numbers can lead to schools being downsized or closed. The thinning out of the offer leads to larger catchment areas and thus to poorer accessibility and higher demands on the student mobility. In the case of infrastructure types, whose visit is optional, e.g., cinemas, this can lead to a decrease in the intensity of use since the mobility effort is no longer proportionate to the benefit. The thinning out of the offer and the associated deterioration in the infrastructure can affect the attractiveness of the region. Providers and users of the facilities move away or decide against moving in or settling down. This can create a downward spiral with negative effects for the region (Flach 2012). Günther et al. (2013) assume a balancing effect with regard to primary school closures, since the decreasing inflows are offset by the decreasing outflows.

The following sections are structured as follows. Section 2 is about the problem context of interdependencies in the field of spatial planning in rural areas. Section 3 introduces relevant data for the analysis of these interdependencies. Section 4 provides an overview on relevant approaches in the field of data analysis. Section 5 describes the vision for the planned interdependency analysis. Finally, Section 6 gives a conclusion.

## 2. Problem context

Understanding the interactions between spatial planning, migration and the well-being of residents is essential for decision-making. New constructions of assisted living facilities, retirement homes or multi-generational housing are a common strategy to deal with the increasing number of older people in rural areas. Such facilities are usually planned, built and operated without explicitly considering their consequences for the demographic structure (Köhler and Schaffert 2015). Holz-Rau and Scheiner (2020) discuss the role of spatial planning in the CO<sub>2</sub>-reduction debate. They say that integrated land-use and transport planning cannot be justified by arguments related to the reduction of carbon dioxide emissions, but can be of use in pursuing other urban development goals. They see the interdependency concept between transport and place as empirically well founded but lacking other dominant societal changes shaping spatial and transport development. They name relevant areas of concern regarding interdependencies in land-use and transport planning. Besides others, they denominate the causality of the interdependencies, which is based on complex chains of effects and not on direct causal relationship between the built environment and transport demand. They also identify the missing temporal stability of transport connections as a problem. Studies in transport are often designed as cross-sectional analyses instead of longitudinal analyses, which may result in a misjudgement of spatial effects (Holz-Rau and Scheiner 2020).

However, what is largely missing in practice, is an understanding of the village as a system of complex interdependencies. Visvizi and Lytras (2018) argue that a concept of a smart village is missing in the academic planning debate. They surveyed 24 papers from the smart city context to formalize key research questions. They addressed mapping, planning and managing as well as well-being as some of the most urgent research areas for smart villages (Visvizi and Lytras 2018).

Strategic spatial planning processes require precise and reliable information on the demand of the planning area. Haußmann (2016) states that cities and districts are the ones that need the finest granularity of statistical data for their tasks. He argues that most significant challenges are overcoming access hurdles to develop suitable data and maintaining the best possible data protection without loss of meaningfulness. Findlay et al. (2015) highlight the relational perspective of migration, namely between groups of people, movers and non-movers, migrants and those with power and resources in the housing and labour markets, the individual mover and the institutions to which they are linked and between the migrant and those in the state who govern migration.

Besides interdependencies related to migration, interdependencies related to well-being are a rather complex but also very promising topic. Research on well-being and quality of life is prevalent internationally and focuses on factors that influence well-being or quality of life in neighbourhoods. For example, Moore et al. (2018) present a review on effects of changes to the built environment on the mental health and well-being of adults. Although seniors are playing an increasingly important role in this field, these studies are largely specific to

cities. The use of sentiment analysis for social media content has become increasingly important in recent years. Trying to develop a geosocial sensor from geosocial media content available for London, Ostermann (2021) concludes that passive observance to publicly available geosocial media, in contrast to pro-active engagement with citizens, seems of limited use to understand and to improve urban quality of life. The generation of a knowledge graph focusing on demographic processes in rural areas in Germany that incorporates fine-grained data is a promising step for the analysis of interdependencies between demographics, spatial planning decisions and individual well-being.

### 3. Data

In Germany, several datasets are available, which might be useful for the analysis of interdependencies in the village system. In the following, some examples will be presented.

Statistical datasets relevant for demographic trends in Germany are provided by the „Statistische Ämter des Bundes und der Länder“<sup>1</sup>. The datasets, which are published annually free of charge and contain migration data, do not include direct migration flows between the statistical units, such as municipalities or districts. Consequently, it is not possible to identify migration links directly.

Stawarz and Sander (2019) used a time-series dataset of annual inter-county migration flows for the years 1991 to 2017 based on data of the Federal Statistical Office of Germany and the Statistical Offices of the Länder. The data were compiled and adjusted for boundary changes by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) to analyse the impact of internal migration on the spatial distribution of population in Germany (Stawarz and Sander 2019).

A spatially more detailed dataset for demographic data is provided by the German census. The information is available in 100 m x 100 m grid cells. The census data do not contain information about the migration flows of the residents.

The municipal population register contains the most detailed and up-to-date dataset on demographics. The statutory dataset contains data about every individual resident of a municipality. According to the Bundesmeldegesetz, the legal foundation and several properties of the residents are recorded, like full name, address, date of birth, sex, religion, academic titles, former names, attorney, nationality, former addresses, day of entry /exit, marital status, date and place of marriage, minor children, name and address of the partner, date and location of death.

Infrastructure facilities are documented in OpenStreetMap, which also enables an export of the full history of the OSM data. The historical data might be used for retrospective analyses.

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<sup>1</sup> <https://www.regionalstatistik.de>

Especially in case of Volunteered Geographic Information (VGI), the data quality has to be considered (OpenStreetMap-Mitwirkende 2021).

There are particular characteristics of rural areas, which might require further attention. Due to the lower population density, lower numbers of cases are to be expected, which may lead to problems in the validity of the analyses. Low case numbers are also a problem in data analyses when data has to be processed anonymously (Schaffert and Höcht 2018). Besides the availability, the quality of the datasets must be maintained – including official datasets like the population register data (Haußmann 2016).

#### 4. Relevant approaches in the field of data analysis

An appropriate data repository is a basis for an extensive data analysis. Due to heterogeneous data sources that are prevalent in urban planning and our focus on interdependencies, it is planned to implement the data repository using a knowledge graph approach. Hogan et al. (2022) deliver a technical overview on the topic. They discuss the definition of the term knowledge graph and define it as a graph of data intended to accumulate and convey knowledge of the real world, whose nodes represent entities of interest and whose edges represent potentially different relations between these entities. The graph of data (a.k.a. data graph) conforms to a graph-based data model, which may be a directed edge-labelled graph, a heterogeneous graph, a property graph, and so on. They see an advantage of a knowledge graph in the use of ontologies and rules, which can be used to define and reason about the semantics of the terms used in the graph. Scalable frameworks for graph analytics can be leveraged to compute centrality, clustering, etc., to gain insights about the described domain. Graphs also allow the data and its scope to evolve in a more flexible manner than is normally possible in a relational setting, particularly for capturing incomplete knowledge. Unlike (other) NoSQL models, specialised graph query languages support also navigational operators for recursively finding entities connected through arbitrary-length paths (Hogan et al. 2022).

Since data quality is an essential aspect for data analysis, it should be mentioned that knowledge graphs are also helpful for plausibility checks on the data (Ege and Paschke 2021). The study of the structure of the knowledge graph might also support the identification of causal loops and the generation of causal loop diagrams. Causal loop diagrams, like the example in Figure 2, are a technique from the research field of system dynamics. For instance, Xia et al. (2021) use causal loop diagrams to better understand the complex interactions of variables affecting the migration of the elderly in the case of retirement villages.

Knowledge graphs have found a broad dispersal in academic research and economic applications. They are already recognized in the field of spatial planning. Chadzynski et al. (2021), e.g., built an ontology based on CityGML 2, named OntoCityGML, and a Semantic 3D City Database as part of The World Avatar project. Von Richthofen et al. (2022)

offer a literature review on the use of Semantic Web Technologies<sup>2</sup> in the field of City Planning. They propose Semantic City Planning Systems (SCPS) at the intersection of City Planning and Semantic Web Technologies to “[...] better support planning practice, and its ability to address the challenges of urbanization, demographic shift and climate change” (von Richthofen et al. 2022). Akroyd et al. (2021) demonstrate how Semantic Web technology could be used to implement a Universal Digital Twin as part of the World Avatar project, which focuses on building a dynamic spatiotemporal knowledge graph that describes the real world and that is maintained by agents (Akroyd et al. 2021). Knowledge graphs have also already been used in the field of smart cities. Santos et al. (2017) use a city knowledge graph for indicator discovery and an automatic generation of resulting dashboards.

From the field of knowledge graph embedding, link prediction and pattern mining seem to be promising approaches for analysing the knowledge graph. Fournier-Viger et al. deliver an overview on pattern mining (Fournier-Viger et al. 2020), whereas Rossi et al. (2021) give an overview on link prediction. By defining single migrations from the population register as links, the prediction of these links could reveal information on the relevant influences. Liu and De Sabbata (2020) used knowledge graphs combined with machine learning to predict urban socio-demographic change using official data sources and volunteered geographic information datasets, in detail London Output Area Classification, UK Indices of Deprivation, distributions of geotagged social media data and Wikipedia articles of London. They framed their socio-demographic change model as a link prediction task (Liu and De Sabbata 2020). Egami et al. (2021) used knowledge graphs and inference rules “[...] to detect vicious cycles from among urban problems, to identify these cycles’ root problems, and to search the related budget information using the constructed KG.” The detected vicious cycles and the root problems were estimated using SPARQL queries and evaluated with domain experts (Egami et al. 2021). Pu et al. (2021) used a spatiotemporal migration knowledge graph framework based on the Global Migration Dataset and the Baidu Encyclopedia to “[...] quickly and accurately obtain the comprehensive knowledge of migration, significantly improve the ability of human being to apply and analyse the knowledge and data of migration, which has wide theoretical and practical value in the field of migration.” (Pu et al. 2021).

Wielechowski et al. (2021) used a cluster-based approach to analyse the existence of interdependencies between human capital determinants and economic development, in detail between GDP per capita and life expectancy, higher education rate, economic activity rate, and internet access and between the number of library users and the regional economic development. Lin et al. (2014) proposed a more network-based approach to identify causal relations. They use such an approach for the clustering and association rule analysis of accident data showing several advantages compared to a K-Means clustering on the plain dataset. An overview on the use of network analysis in the field of migration was given by

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<sup>2</sup> <https://www.w3.org/standards/semanticweb/>

Pitoski et al. (2021). Stochl et al. (2019) use a quantitative approach using network analysis to find the most central elements based on four surveys with 47.578 participants to identify significant aspects of psychological well-being in different cohorts.

## 5. Vision for the interdependency analysis

The analysis of interdependencies is essential for sustainable spatial planning processes in rural areas. Starting points from different research fields and datasets exists but have to be adapted and combined to develop the basis for the analysis of the village system. Hence, the current work aims to create a model for studying and visualizing interdependencies, in particular between supply facilities, demographics, settlement structures and individual well-being in rural areas in Germany. Its goal is to incorporate the heterogeneous fine-grained data sources and implement the relations between the individual influencing factors. The design of the model should contribute in answering the following research questions:

- Is the construction of a retirement home linked to the migration of older people (RQ1)?
- Is the designation of new zonings for single-family homes in spatial planning documents linked to the migration of younger people (RQ2)?
- How is the individual well-being of SFHA's residents affected by influencing factors like communication infrastructure, green space, leisure facilities or supply infrastructure (RQ3)?

Generating a knowledge graph focusing on demographic processes in rural areas in Germany is a promising step to build a model, which can answer these research questions. It includes the technical implementation of the knowledge graph and the preparation and integration of heterogeneous datasets. A geographic uplifting and interlinking to existing concepts of other relevant knowledge graphs must be implemented. The population register includes detailed information on the migration for each resident. Therefore, it seems promising to design the analysis model for RQ 1 and 2 with particular focus on the population register. Furthermore, the model should also represent the relations between the single elements, e.g., within the population or between people and the retirement homes. For the analysis, longitudinal (e.g. comparing population developments over time) and cross-sectional (e.g. comparing different SFHA) analyses seem to be relevant. Adam et al. (2018) see longitudinal studies in selected example districts as an essential approach to researching the course of transformation processes in SFHA. Therefore, the analysis model includes time-series data as well.

Implementing a knowledge graph also seems promising for further issues besides the data analysis. One advantage could be related to the privacy requirements. Geiger et al. describe a semantic approach to anonymization using inference-based AI and active ontologies (Geiger et al. 2020). Furthermore, one can extend the database to provide answers to related questions. The validation of the datasets could also be implemented to check for contradicting data. Finally, the knowledge graph could be a starting point for further applications,



e.g., the implementation of chatbots or multi-agent systems (MAS). A chatbot could be applied for public participatory processes in spatial planning or data collection. Dorri et al. (2018) present a comprehensive discussion of all aspects of MAS and provide a classification on MAS applications in which they identify cities and built environments as one of the five classes (Dorri et al. 2018).

The acquisition of well-being data is also a relevant work package. Therefore, one needs to apply methods to obtain such qualitative data. Especially for the identification and validation of subjective interdependencies related to well-being, qualitative methods like expert interviews or surveys are considered for causal loop diagrams. Natural language Processing (NLP)-techniques could support the extraction of interdependencies. The resulting interdependencies and causal loops could then be discussed with the experts again or verified by a data analysis. Complementary data sources, like social media, can be applied but seem less promising, especially since the focus is on rural areas.

## 6. Conclusion

Considering interdependencies in spatial planning processes is vital for sustainable spatial planning decisions in rural areas. Therefore, the first challenging step is to understand the complex relations in the village system. The approach presented here, uses a knowledge graph that incorporates heterogeneous data sources and analyses the complex associations between the influencing factors. The aforementioned existing examples show that there are already starting points from different research areas. Knowledge graphs already have a broad academic and practical use. Their use is relevant as a simple data repository and supports data analysis and the handling of datasets with privacy concerns. These research fields have found increasing attention in recent years. Knowledge Graphs have also already found its way into spatial planning. Approaches focusing on the relevant interdependencies, especially in rural areas, are missing in Germany. Against the background of an ageing population in Germany's rural areas, the analysis of such interdependencies is a valuable aspect of sustainable spatial planning. The research approach presented here should lead to a significant contribution.

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# Public Value Capture in Connection with Large Infrastructure Projects

## Abstract

Public value capture (PVC) is an essential phenomenon to improve the refinancing of public infrastructure and keep the necessary budget for other important duties like education, health and social care. An important but little explored aspect is public value capture in connection with large infrastructure projects such as major transport infrastructure.

International best practices have indicated that governments typically employ recurring tax- and fee-based mechanisms. However, non-recurring forms became more and more important over the past 20 years and contract-based value capture are among the most evolved value capture techniques available today.

All instruments presented in this article require data for the calculation of payments. Unfortunately, it is not possible to give general numbers for the impact of new infrastructure. An individual analysis is required for each development.

The tools presented share the idea that those who have an advantage from the new infrastructure should be targeted for funding. However, the rational is different in detail. In general, there are several well established non-recurring tools for funding the project, if the public sector owns the land or the public sector can offer development rights in exchange for financial contributions of the developers.

## 1. Introduction

Developing infrastructure is generally not a stand-alone project but part of the creation of new economic corridors that will deliver transformational urban regeneration (Asian Development Bank, 2021). A lack of public transport accessibility impacts primarily on the urban poor, who tend to live on the urban peripheries. The reason is the heavy reliance on the automobile as the main transport mode while poorer population groups cannot afford it. (Romana Medda, 2011).

The shortage of financial resources is a Europe-wide problem. Countries as well as regions and municipalities have decreasing means to fulfil all their public commitments. Important reasons for this are global crises such as the financial crisis, the Covid19 epidemic and the inflation, as well as European crises such as the wave of refugees, the Brexit and the war in

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Ukraine. Modernising the governance is a way to relieve economic and budgetary pressures, to design and deliver needed structural reforms, to remove existing barriers and to foster innovations. Public value capture (PVC) is an essential phenomenon to improve the refinancing of public infrastructure and keep the necessary budget for other important duties like education, health and social care. For this reason, it is one of the key factors of responsible land management and smart tools are needed for a successful implementation (Hendricks 2020). The interest in this topic has recently grown exponentially among scholars and practitioners (Vejchodska et al. 2022). In current literature, a wide agreement exists on capturing value from infrastructure improvements and public services. An important but little explored aspect is PVC in connection with large infrastructure projects such as major transport infrastructure. For this reason, this paper aims to extend the research in this area. The starting point will be a systematic literature analysis to discuss existing tools for this issue.

“Unearned increment” is internationally used for any rise in land values whether due to public decisions or to the general economy, instead of landowners’ own initiatives and efforts. The term “unearned” helps to justify the process and provides a rationale for the introduction of value capture instruments (Alterman 2012). “Land value capture” (LVC) is a commonly used term. This term refers to a policy approach that enables communities to recover and reinvest land value increases resulting from public investment and other government actions. Also known as “value sharing”, it is rooted in the notion that public action should generate public benefit (Land Portal 2020). In general, PVC includes land value capture and more and the term is used in a more comprehensive way. In our paper, we will share the following definition of Hendricks et al. (2022):

“The term of public value capture includes all instruments that capture all possible increases of the value of land and buildings, whether they are considered as taxes or not. It focuses primarily on capturing unearned benefits resulting from actions other than the landowner’s. The resulting funds may be earmarked for specific purposes (e.g. recovery of development costs or provision of affordable housing)”.

In the literature different classifications of value capture can be found, based on its purpose or its outcome. In this paper, we share the view of Hendricks (2022). We distinguish basically between recurring and non-recurring forms of PVC.

## 2. Methodology

In this theoretical research, the tools for PVC in connection with large infrastructure projects are examined in the form of a discursive literature analysis. The available literature on the mentioned issue is systematically summarised and presented in a new, generalising way. This is not a purely additive or synoptic presentation of the results, but the scientific added value results from the synthesis of different sources. To this end, the available material was first collected, then subjected to an assessment of quality and relevance and finally brought together in a synthesis (Lueglinger and Renger 2013). The literature analysis covers the most

authoritative publications on the subject, in the past twenty years. Publications from both open access and non-open access platforms were reviewed. In addition, the literature analysis also reveals the need for further research.

### 3. PVC/LVC in connection with large infrastructure projects

PVC can be used as a tool to finance capital intensive infrastructure projects without additional traditional taxes or fees and related public opposition. Values which can be captured may include not only direct revenues from incremental land value increase, but long-term revenues from further development in the area. PVC is not only considered as a financial instrument, but also as a planning and policy instrument to promote economic competitiveness, environmental sustainability and social equity (Suzuki et al., 2015).

PVC tools most suited to finance large infrastructure projects can be classified into recurring and non-recurring tools.

Recurring tools include:

- Special Assessment, Business Improvement or Community Benefit districts;
- Tax Increment Financing;
- Location Benefit Levy or Land Value Tax with additional transit component;
- Transportation Utility Fee;
- Income or Payroll Based Tax;
- Transit focused Property Transactions Tax.

Non-recurring tools include:

- Development Agreement, Development Contribution or Planning Gain;
- Community Benefits Agreement;
- Joint Development or Joint Development Agreement;
- Sale/lease of Development/Air rights or Up Zoning/Density Bonuses/FAR;
- Transit-focused Development Fee;
- Land Readjustment Scheme.

The tools are explained in more detail below.

#### 3.1 Recurring PVC tools

*Special Assessment, Business Improvement or Community Benefit Districts* are specifically designated districts, which benefit from an improvement, and which may choose to self-impose an additional tax to help finance the improvement. These special assessments are generally approved through some form of vote by the group that will be paying the tax. This group could be local landowners, local residents, or local businesses. The taxes are usually meant to finance a portion of the local infrastructure investment rather than to subsidize the system operating costs (Salon, 2014; Arroyo, 2020).



The Washington Metropolitan Area Transit Authority raised a substantial portion of the capital costs for two infrastructure projects using Special Assessment Districts (Salon, 2014). In London, the South Bank Employers' Group, a partnership of 18 major employers in the area, created the Business Improvement District to help regenerate the area, improve visitor experiences, and diversify both its uses and its revenue streams. On the other hand, an example of a Community Benefit District is Yerba Buena in San Francisco, USA (Arroyo, 2020).

*Tax Increment Financing* (TIF) uses anticipated future increase in tax revenues to finance current improvements that are expected to generate those increased revenues (Arroyo, 2020). It is essentially a surtax on properties within an area to be redeveloped by public investment financed by municipal bonds (Suzuki et al., 2015). The city of Chicago in the US, Transport for London, the city of Toronto, Canada and Belo Horizonte, Brazil are all examples where TIFs have been used to finance transport projects (Martinez, 2010).

*Location Benefit Levy or Land Value Tax* with additional transit component are taxes on the value of land in the vicinity of a public transport amenity. This mechanism is a tax on the land only, and this is distinct from a conventional property tax (Salon, 2014; Martinez, 2010). In London, this tax is called the "Business Rate Supplement", and is collected on all existing commercial buildings that rent for more than £55,000 per year in the Greater London area (Salon, 2014).

In the US transit-focused property transaction taxes can also be charged. New York City collects the Mortgage Recording Tax when properties are sold. The collection rate fluctuates with the real estate market, but in 2012, this tax raised slightly less than \$300 million for the transit agency (Salon, 2014).

The *Transportation Utility Fee* (TUF) is a tax based on the principle that links the benefits of operation of a transportation system to existing activities. Each type of activity is generally levied based on its trip generation rate, leading to a higher tax burden on non-residential properties. The fees can be used to finance construction of new transportation services or to cover the maintenance costs of the existing system. TUFs have been widely used in several states in the US with varying rates of success (Martinez, 2010).

When one considers the *Income, Payroll-based or Employer tax*, income earners or employers in the region served by the transit system pay an extra increment of income or payroll tax that goes to the public transport agency (Salon, 2014). In France, this was previously known as *Versement Transport* now *Versement Mobilité* and every employer (private or public) with more than 11 employees, who is located within the area managed by a transport authority may be asked to pay a percentage of its total payroll as a transport tax to the authority (Ministère de L' Économie, 2022).

The latter two tools may be considered as indirect tools of value capture, since it is not the increase in the value of land and/or building which is being captured, but they are rather

related to the number of trips carried out or the number of employees employed in a specific area.

### 3.2 PVC versus LVC

Recurring instruments usually do not separate between the value of buildings from the value of the land. A comparative analysis of 29 European countries has shown that “few countries distinguish between land and the buildings, whereas most countries tax the property as a whole including land and building” (Halleux et al. 2022). For this reason, it is reasonable to use the comprehensive definition developed in Chapter 1 to discuss all options of PVC including recurring forms.

The situation is more difficult for the discussion of non-recurring forms. Generally, public value capture focuses on “unearned benefits”. It is commonly accepted that land value increases fall into this category (cf. Chapter 1). There may also be unearned benefits for constructions, provided that the increase in the value of the property exceeds the construction costs. This is regularly the case in regions with high real estate prices. Several external factors influence the level of prices. Economists stress the price determination as the interaction of supply and demand. The determinants of rising land prices either work as drivers of the demand side or barriers on the supply side. Changes such as population increase and local economic growth are important drivers on the demand side. Moreover, public services (especially technical infrastructure) and public-sector expenditures, promoting the quality of life in the city, are reflected in property values. Furthermore, environmental amenities such as a mild climate or a location close to water bodies or mountains may have an influence. These factors are also well known in real estate valuation. They are generally discussed under the notion “macro location”. Therefore, from a legal-philosophical point of view, capturing parts of these benefits may be basically justified.

However, there is a problem of valuation. It is generally accepted that the residual method leads to uncertain results, if a relatively small residual (total return) is derived from much larger input variables. The calculation of earnings and investments relates to transactions in the future and is therefore based on assumptions. For this purpose, lump sums are used as empirical values (e.g., construction costs, land values, rents, and interest level). It is disputed to what extent any interest for loans to finance the development should be included in the calculation. The input variables are therefore subject to a certain degree of uncertainty. However, this (relatively) small uncertainty in the input variables leads to a very large uncertainty in the result due to the unfavourable error propagation of the procedure (Hendricks et al. 2021).

Therefore, there are good reasons for taking into account the return from constructions but also good reasons to focus on land value gains. On the one hand, land value gains are undisputedly unearned gains. On the other hand, considerable larger investments are necessary to achieve a return from constructions and the return is very small in relation to these investments. Therefore, we will focus on LVC in our analysis.

### 3.3 Non-recurring PVC tools

A *Development Agreement (DA)* is a voluntary, but legally binding, contract between one or more developers and a local government. In a DA, developers provide upfront contributions for public improvements and in exchange, the local government grants them the vested development rights, where local zoning and land use entitlements that apply to developers' projects remain unchanged for the duration of the contract. By locking the entitlements for a longer period than otherwise possible, DAs make it easier for developers to secure the upfront financing and protect their investments from potential cancellation in project mid-stream (FHWA, 2020). The term Development Agreement is widely used in the US. In other countries, these agreements are also referred to as *Developer Contributions*, *Developer Obligations* or *Planning Gains*. Planning Gains, also known as Section 106 Agreements in the United Kingdom, or 'planning obligations', refer to developer obligations to obtain planning approval and require additional contributions provided to the Local Planning Authority.

In terms of transportation infrastructure, DAs can be a useful technique in capturing and monetizing anticipated property value increases from new developments along planned major highway corridors or transit-oriented developments (TODs). These capital project-induced DAs can be at corridor level involving multiple jurisdictions or at an individual intersection or station involving a single jurisdiction. In most cases, however, DAs are driven by major real estate development projects initiated by developers and include provisions for additional infrastructure capacity needed for their projects (FHWA, 2020).

On the other hand, *Community Benefits Agreement (CBA)* is a voluntary but legally binding contract between a developer and community representatives committing the developer to fulfil specific obligations for the benefit of the community (e.g. jobs for local residents) in connection with a development project. In exchange, the community provides their support (or at minimum, their acquiescence) for the proposed projects (FHWA, 2020). This is not a PVC tool in the strict sense, but we have included it in our overview for the sake of completeness, as it is a very interesting tool for attracting residents.

In the US the difference between DAs and CBAs is that the former is signed with local governments, whilst the latter is signed with communities. Whilst there are numerous examples of CBA in the US, most of which are linked to major real estate development projects, CBAs associated with dedicated transportation projects are less common, especially those related to highways (FHWA, 2020). In 2005, Georgia STAND-UP succeeded in attaching community benefits language to a City ordinance authorizing almost \$2 billion in public funding over a 20-year period for transit-oriented development. The Atlanta BeltLine project involved the development of a 22-mile light rail transit loop encircling the city. The \$2.8 billion project is expected to take 25 years and includes transit-oriented design (FHWA, 2020).

A *Joint Development (JD)* is another form of non-recurring tool, where a partnership is formed between the private sector and the local government or public transport agency to

build a real estate project on land controlled by the public sector. The local government or public transport agency captures value by requiring a private developer partner to build a portion of the station amenity as part of their real estate project, thereby reducing their capital costs (Salon, 2014). In other cases, this is also referred to as a *Joint Development Agreement* (JDA), where a public transportation project that integrally relates to, and often co-locates with, commercial, residential, mixed-use, or other non-transit development (FHWA, 2020).

An US example of a Joint Development Program is the one adopted by the Washington Metropolitan Area Transit Authority (WMATA) in connection with the construction of its metro lines. However, the financial contribution and the physical scale of WMATA JD projects are much smaller than those of the more renowned practices in Asia such as Hong Kong, China and Tokyo (Suzuki et al., 2015).

In the *Sale or Lease of Development/Air rights*, the local government or public transport agency acquires land in and adjacent to the public transport facility at the going price before ground is broken to build the public transport system. After the system is built (or concurrently), the owner can enter into long-term leases with developers for ground, air, or subsurface development rights. The added value from the public transport system is capitalized into the lease price (Salon, 2014). Similarly, governments can sell air development rights extended beyond the limits specified in land use regulations (e.g., FAR) or created by regulatory changes to raise funds to finance public infrastructure and services.

Amongst the best-known air rights sales are the ones in São Paulo, Brazil. The city government uses the *Outorga Onerosa de Direito de Construir* (Additional Building Charge; OODC) and Certificates of Additional Construction Potential (CEPACs), as value capture instruments to finance local infrastructure investment. CEPACs are a market-based instrument to finance public urban investments through air rights transactions within designated urban operations. Through CEPACs, municipalities can raise infrastructure investment funds by selling the bearer additional building rights, such as a higher FAR and possible land use changes, that should induce private investments in the transformations wanted by urban development policy (Suzuki et al., 2015).

Through *Transit-focused development fees*, developers working in the vicinity of a public transport system pay extra fees for the privilege of building new real estate projects (Salon, 2014). In London, these fees are called the *Community Infrastructure Levy* (CIL) and are collected on most new building permits in the Greater London area. The CIL revenue will finance part of the Crossrail project (Salon, 2014).

In San Francisco a transit-focused development fee has been in place since the 1980s. The Transit Impact Development Fee exempted residential development, which means that it had not been a large source of revenue for the San Francisco Municipal Transportation Agency, since most development in the past decades in San Francisco had been residential. In 2015 a Transportation Sustainability Fee was introduced, whereby a charge for residential development was included, and the collected funds are available for all sustainable

transportation modes such as transit, pedestrian and cycling infrastructure (Salon, 2014; San Francisco Planning, 2022).

In *Land Readjustment Schemes*, landowners pool their land together for reconfiguration and contribute a portion of their land for sale to raise funds to partially defray public infrastructure development costs (Suzuki et al., 2015). This can be used as a development-based LVC instrument to finance transit and TOD-related investments.

Land readjustment can efficiently assemble the rights of way for guided transit extension projects and simultaneously promote transit-supportive property development around new stations, mainly in suburban areas, if all landholders agree. Land readjustment originated in Germany. Since then it has been used extensively across East Asia, where it was adopted by Japan, the Republic of Korea and Taiwan (Suzuki et al., 2015).

#### 4. Issues: Valuation and geographic range

##### 4.1 General observations

Most of the tools mentioned above require information to what extent the construction of new roads, bridges, or tunnels capitalizes into land values. For this reason, information concerning the value uplift is valuable for households, realtors, local housing developers, and governments (Osland, 2008). It enables especially local governments to try out new finance mechanisms rather than hanging on to their existing ones (e.g. tax increment financing; Hass-Klau 2004).

The distance from the central business district (cbd) is one of the main factors contributing significantly to explain the intraregional spatial variation in housing prices (Osland, 2008). For example, a market analysis in Shanghai from 2008 shows clearly the impact of distance to the city centre on housing prices. In this study the distance in kilometres and the availability by public transport was included, but it was not based on the travel time (Chen and Hao, 2008). Another paper demonstrates the influence of decreasing travel times due to a new subway line on property values (Hiironen et al., 2015). The modelling of distance by travel time is crucial for this paper, as the quality of the road network and the public transport influence the travel time but not the physical distance. However, the influence of the travel time depends basically on the size of the infrastructure project (local or regional), the quality of the local transport system and the monocentric or polycentric structure of the municipality (as explained below).

Regional infrastructure projects (e.g. motorways or lines for long-distance trains) have a considerably larger impact than local projects. For example, the construction of the new high-speed railway line between the major German cities of Frankfurt and Cologne and the construction of a new railway station in Montabaur have significantly reduced the travel time to the two economic centres. This resulted in a significantly above-average increase in land value for both the municipality of Montabaur and the associated district in the period from 1995 to 2002 (the railway line was opened in 2002). The land value increases were

80% in the municipality, 64% in the district and 32% in the federal state of Rhineland-Palatinate (Reuter 2011). However, the impact on land prices on a local scale is relatively similar. Therefore, in our paper we focus on the effects of large infrastructure projects on a local scale, which are analysed in more detail in Sections 4.2 and 4.3.

The quality of the transport system is important to answer the question, if the land values depend more on the quality of the road network or on the quality of the public transport system. In large cities with very good public transport, its impact is considerably stronger than in rural areas, where there are no or only poor public transport connections and people are therefore generally dependent on the car. For example, an analysis has shown that the distribution of land values in Munich can essentially be explained by travel times by public transport, whereas in the rural district of Lüchow-Dannenberg, the quality of the road network is price-determining. The relevance of public transport in cities is based on practical (no traffic jams, no parking problems) and ecological reasons. In view of the climate crisis and the decreasing importance of the car as a status symbol, it can be assumed that public transport will become even more important in the future.

One of the most obvious weaknesses of the monocentric model is the assumption that firms and hence jobs are entirely located in the cbd. The inclusion of sub centres outside of the central part of the study area contributes significantly to explain spatial variation in land values (Osland, 2008). However, the development of infrastructure is based on the analysis of traffic flows and accordingly, a high level of interest in its development is to be expected and thus also reactions on the real estate market. But these can be lower in a polycentric model than in a monocentric model. A gravity-based accessibility analysis can be an approximation towards accounting for how changes in the transport network may manifest itself and have spill-over effects throughout a region (Osland, 2008).

#### 4.2 Geographic range

The impact of the distance to the city centre on the price formation is too small in the immediate vicinity of the centre. There is a nearly linear connection not before the distance is bigger than about 5 km (Hendricks, 2016).

The geographic range of stations of new subway or train lines depends on different circumstances. On the one hand, the distance of stations of the new line is of importance. The maximum geographic range is half of the distance to the next station (FHWA, 2020). On the other hand, already existing lines of public transport have to be taken into account (Hiironen et al., 2015).

An empirical study based on formal statistical modelling using multivariate techniques, direct observations of market property prices in the neighbourhood of a station and professional judgement of local estate agents, property valuers or developers identified the highest value increases between 200 and 500 metres from the station (Hass-Klau, 2004). Similar results have been found in a literature review by Hiironen et al. The authors

identified the highest impact within a distance of 400 metres and still considerable effects up to 800 metres (Hiironen et al., 2015).

#### 4.3 Valuation

The data in the literature on value development in the vicinity of railway stations show a relatively large variance. The literature review of Hiironen et al. (2015) identified price increases for residential properties from 3.2 to 33% (average 10.0) within a radius of 400 metres and from 2.4 to 6.9% (average 4.9) for a distance between 400 and 800 metres. A study for the European Metropolitan Transport Authorities (EMTA) indicates the following land value increases: 10–65% for vacant building land, 3–20% for housing, 4–25% for offices and 6–18% for retailing (highest values between 200 and 500 metres; Hass-Klau, 2004). The announcement of the construction of new lines and the announcement of the stations' locations already result in price increases. However, there might be also a negative effect, if the property is very close to the station (up to 100 metres depending on the mode). Possible explanations are increasing noise and pollution because of the new station (Agostini and Palmucci, 2008) or a feared worsening of the crime statistic (Hiironen et al., 2015). A statistical analysis for Munich detected that a reduction of travel time by public transport of one minute, results in a price increase of residential building land of 4.2 €/m<sup>2</sup> (Hendricks, 2016).

In total, it is not possible to give general numbers concerning the impact of new infrastructure. An individual analysis is required for each development. Important factors are the size of the infrastructure project, the quality of the local transport system, the monocentric or polycentric structure of the municipality, the distance of stations, the existing transport network, the emissions of the new infrastructure (noise and pollution) and the sub-market of the real estate market (e.g. residential, offices, retail). Determining reliable values requires both the necessary data and the necessary expert knowledge.

### 5. Discussion / Conclusion

For the effective implementation of value capture, there must first be a clear identification and quantification of the positive effects of the new infrastructure on economic productivity. Additionally, the key beneficiaries of these economic and commercial gains must be identified. Once these inputs are available, the value capture framework provides a range of tools that can be used to harvest a share of the economic uplift. Value capture mechanisms have been identified that could be implemented by local and national governments (Asian Development Bank, 2021). The direct global application of specific public value capture tools may not be possible, due to the contextual circumstances tied to some of these tools, however similar approaches can be applied globally, on a city, regional or national level, as illustrated in Section 3.3.

International best practices have indicated that governments typically employ recurring tax- and fee-based mechanisms. However, non-recurring forms became more and more important over the past 20 years and contract-based value capture techniques – such as



Development Agreements, Community Benefits Agreements, and Joint Development Agreements – are among the most evolved value capture techniques available today. They provide more flexible and less litigious solutions to generating new revenues (FHWA, 2020).

The tools presented share the idea that those who have an advantage from the new infrastructure should be targeted for funding. However, the rationale is different in detail. Pure land value capture instruments are Location Benefit Levy/Land Value Tax, Development Agreements, Joint Development Agreements, Sale or Lease Development Rights, Community Infrastructure Levy and Land Readjustment. In contrast, the Transportation Utility Fee and the Employer Tax are essentially based on improved accessibility. Community Benefit Districts and Tax Increment Financing have a mixed rationale as they spread the burden between landowners and business people. All these instruments also have a kind of social profile, as beneficiary landowners, business owners or job holders are called upon to finance the infrastructure. This can keep user fees low for socio-economically weaker groups. Finally, Community Benefit Agreements focus more on increasing the support of the project than its funding.

All instruments presented in this article require data for the calculation of payments. In particular, the difficult questions of how large the geographical range is on the price development in the vicinity of new stations and how the price development is to be quantified have to be answered. Unfortunately, it is not possible to give general numbers for the impact of new infrastructure. An individual analysis is required for each development. In general, there are several well established non-recurring tools for funding the project, if the public sector owns the land or the public sector can offer development rights in exchange for financial contributions of the developers. However, the majority of the revenues go to private property owners. They have the actual possibility to collect the value increase by selling their properties (Hiironen, 2015). For this reason, our future research will focus on the development of a non-recurring tool to capture the land value increase of existing real estates in the development area.

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# Automatic Speech Recognition, Interviews and Qualitative Geoinformatics

A mixed method workflow on student's sketch mapping behavior

## Abstract

In the summer semester of 2021, students of Mainz University of Applied Sciences mapped their everyday locations in Mainz, Germany. The students had to map their five everyday places where they respectively “feel good,” “feel uncomfortable,” and “have suggestions for improvement.” Subsequently they were interviewed on their mapping behavior to investigate their decisions to set the points that mark the respective places. In this research, a qualitative GIS approach was conducted to integrate non-quantitative data by using epistemologies traditionally employed with qualitative research, but less costly. The use of a semi-automated speech recognition toolkit reduced the time and effort required for transcription, while content analysis provided qualitative context insights in mapping student behavior. The analysis showed that sketch maps are constructed based on historical personal experiences and group-specific shared circumstances. How do students sketch map? The significance lies in the progressive relation between socio-spatial structure, collective and individual experiences.

## 1. Introduction

Since Kevin Lynch (1960) wrote about mental representations in urban environments, researchers have become increasingly interested in cognition and mapping. Sketch maps are cartographic and cognitive representations of individual or group experiences created by placing location markers on geo-referenced base maps (Boschmann and Cubbon 2014). Recent studies have addressed socio-spatial factors that influence the quality of sketch maps (Hátlová and Hanus 2020), constancies between sketch maps and real-world objects (Tang et al. 2020), students' everyday perceptions of socio-material infrastructure (Kaminski and Schaffert 2021), or students' perceptions in relation to local crime data (Prener 2021). However, these studies address the emergence of spatial patterns or benchmark their qualities rather than discussing their origins in cultural, social, and political factors. In-depth interviews and GIS could be a methodological approach to address these structural factors and support smarter and more group-oriented spatial planning through socio-spatial context. However, such approaches are still not common in geographic information science (GIScience) due to the time and effort required for interview transcription (Strzelecka et al. 2017, Brown et al. 2017).

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Since the 1970s, automatic speech recognition systems based on manuscript rules and grammars have evolved via statistical models and machine learning techniques to a third generation using deep learning techniques such as neural and deep neural networks (Rabiner and Juang 2008). While proprietary cloud and voice-activated assistance systems, such as Google Speech-to-Text, Amazon Alexa, Apple Siri, Watson, LibriSpeech, and Dragon, are less laborious for transforming audio material into textual data than manual transcription methods (Malik et al. 2021, Han et al. 2020, Moritz et al. 2020, Anggraini et al. 2018, Bohouta and Kępuska 2017), privacy and confidentiality remain unclear for researchers and participants (James and Busher 2016). At the same time, more transparent, data-secure, open-source and locale-usable libraries exist, such as Mozilla DeepSpeech, Wav2Letter, SpeechBrain, Kaldi, Coqui, and vosk-api (Malik et al. 2021, Martins et al. 2021). However, less elaborate automatic transcription for the (social and spatial) sciences continue to be absent from transcription work (Haeb-Umbach et al. 2020, Hoxtell 2019).

Research on speech recognition is mainly focused on machine-oriented, semi-supervised (Zhang et al. 2020) machine-learning neural networks (Wang et al. 2019, Qin et al. 2019, Ren et al. 2019), and deep-learning language models (Kriman et al. 2019, Yu and Deng 2014). Furthermore, benchmarking of proprietary and open-source tools (Park et al. 2020) and noise reduction (Li et al. 2014) are also common. To date, there have been only a few thematic studies and approaches to speech recognition, such as in psychotherapy (Miner et al. 2020), emotion recognition (Mirsamadi et al. 2017), and robotics (Martins et al. 2021), while workflows beyond technical implementation have hardly been described.

This paper outlines a mixed-methods workflow on semi-automatic speech recognition and qualitative research on sketch mapping behavior. During the summer semester of 2021, German students at the Mainz University of Applied Sciences mapped their everyday experiences of places in Mainz in the context of “feeling good”, “feeling uncomfortable”, and “suggesting improvements”. Afterwards, students were interviewed about their mapping behavior to investigate their mapping decisions.

## 2. Methodology

### 2.1 Interview design, conduct and audio postproduction

After reviewing the sketch maps, a semi-structured interview catalog was created. The quality of the catalog depended on the way the questions were formulated (Helffferich 2011). To avoid redundancy, encourage participation, the first draft of questions was reviewed for unnecessary redundancies, closed and suggestive questions, and contradictory and thematically bloated phrasing. However, the semi-structured interview also represented an open-ended interview format so that emerging themes could be addressed and discussed throughout the interview. The interview catalog included questions to identify technical mapping problems as well as circumstances that influenced mapping behavior.

All interviews were conducted during lecture by the video conferencing tool Zoom. Group interviews were conducted with 28 students who formed seven groups of three to five

participants. Participation was voluntary to reduce the performance pressure and to obtain objective answers in a classroom setting. Respondents spoke at varying levels of volume and clarity, and combined with different hardware settings and background noise, the recordings were of inconsistent quality. To improve the audio quality for better transcription results, audio post-production was performed (Kah 2015). Open-source software Audacity was applied to reduce background noise, to keep the volume constant (compressor effect) and to “normalize” the amplitude without distorting the audio signal. In total, the seven interviews ranged from 10 to 23 minutes and a total of one hour and 41 minutes.

## 2.2 Semi-automatic speech transcription

The interview corpus was transcribed verbatim with the free and open-source automatic speech recognition toolkit `vosk-api`. `Vosk-api` requires Python 3.5–3.9 and pip 20.3 (but also works in C, Go, Java, etc.) and can be installed and run on Windows, Linux, iOS, Android and Raspberry Pi (Alpha Cephei 2015). The program had been cloned/downloaded via the respective Git command from the Alpha Cephei GitHub-repository (Table 1).<sup>1</sup>

Table 1: Commands

Purpose	Command
Clone	Git clone, <a href="https://github.com/alphacep/vosk-api">https://github.com/alphacep/vosk-api</a>
Download model	<a href="https://alphacephei.com/vosk/models/vosk-model-de-0.21.zip">https://alphacephei.com/vosk/models/vosk-model-de-0.21.zip</a>
Execution	<code>python test_srt.py audio.mp3 &gt; foo.txt</code>

The out-of-the-box and open source (Apache 2.0 license) machine trained German language model (`vosk-model-de-0.21`) with a size of 1.9 GB was downloaded. This model had already been trained by the developers on speech recognition datasets (Povey 2015). This included phrases from a variety of text genres, such as Wikipedia and parliamentary speeches (Milde and Köhn 2018) to assign words to specific audio frequencies and phonetics (ibid.). Depending on which dataset the `vosk-model-de-0.21` had been trained and then tested on, it has a word error rate ranged from 9.83% (Tuda-de test) to 33.26% (mtdex)<sup>2</sup> (Alpha Cephei 2015). By default, the text output consisted of a long continuous text. Hence, the script was adjusted from seven to 25 to 30 words per line to obtain several separate transcribed sentences. The library was run without online/cloud background processes (Alpha Cephei n.d.) by a single command in a Command line tool (Windows `cmd.exe` or unix-like operating systems shell/bash) (Table 1).

<sup>1</sup> For Git-installation or zip download, see GitHub 2022. It is also possible to download the zip file from “GitHub-repository”.

<sup>2</sup> For more Information about training of corpus and acoustic models in speech recognition, such as Tuda-de test or mtdex, see Radeck-Arnetz et al. (2015).



## 2.3 Inductive coding

After spelling and grammatical errors were corrected, transcripts were qualitatively analyzed using inductive coding. Following Mayring's (2014) qualitative research method, the text passages were evaluated flexibly but systematically and sorted into codes. Any relevant code was abstracted directly from the material without making any prior assumptions. The first step of coding had to be as detailed as possible, since the relevant information and patterns were not yet known when analysing the first interview. In addition, the automation of transcription resulted in less detailed insights into the source corpora for the researcher. In the course of coding, the codes were reduced more and more to basic codes, so that eventually specific generic themes were formed under which the codes could be subsumed.

### 2.3.1. Detailed to basic

During the analysis of the first interviews, the most detailed possible designation of the codes was used, which, however, became more and more precise in the course of the coding process. For example, the phrase "I also thought more about the time before Corona, what I liked to do or where I saw places typical in Mainz." initially became the code: "Typical places, in Mainz visited before the Corona pandemic." As the analysis progressed, it became clear that Corona did not only refer to student activities in the past, while typical places became insignificant. Therefore, the former detailed code was aggregated into the codes "In the past" and "Corona" (see Figure 1).

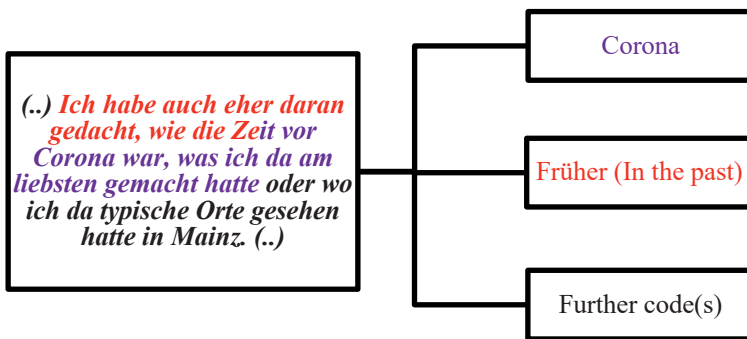


Figure 1: Coding process<sup>3</sup>.

### 2.3.2 Explication, theme creation and counting codes

After 50% of the coding process, the codes were reviewed, themes were created and defined. The small-scale text-logical explanation method<sup>4</sup> was used to define and distinguish generic

<sup>3</sup> Translation of Figure 1: I also thought more about the time before Corona, what I liked to do or where I saw typical places in Mainz.

<sup>4</sup> The small-scale text-logical (German: kleinraumtextologisch) explanation method is a translation by the authors, as there is no equivalent English term.

topics (themes) by encompassing text-immanent aspects as well as the research interest (reasons of mapping behavior) (Mayring 2014). Thus, the themes *mapping experiences* and *mapping circumstances* were created. The theme ‘mapping experiences’ was defined in relation to individually experienced situations, whereas codes were sorted under the theme ‘mapping circumstances’ (Figure 2), which revealed collectively connoted reasons (Figure 2). Then, the respective frequencies of the codes were calculated in relation to each theme (Figure 2) and corresponding statements were paraphrased (Figure 3).

Mapping experiences	Mapping circumstances
<ul style="list-style-type: none"> <li>• In the Past (früher) - 44%</li> <li>• Projected from home (zuhause) - 19%</li> <li>• Mapped at home (zuhause gesetzt) - 23%</li> <li>• ...</li> </ul>	<ul style="list-style-type: none"> <li>• Corona - 73%</li> <li>• Society - 13%</li> <li>• Freshman - 11%</li> <li>• ...</li> </ul>

Figure 2: Themes creation.

id	time	int	Textstelle	Mainzer	früher	zuhause	zuhause gesetzt	erkundet	Gesellschaft	Corona
29	06:34	3	Ja, also bei mir war es ähnlich, ich habe auch eher daran gedacht wie die Zeit vor Corona war, was ich da am liebsten gemacht hatte oder wo ich da typische orte gesehen hat in Mainz. Und bei Verbesserungen und bei ungeren da habe ich halt die Tabelle freigelassen, weil dann konnte ich mir keinen Reim draufmachen, was ich am besten auswählen würde, sage ich jetzt mal.		0					
35	10:26	3	Also mir fehlt, das Treffen mit Freunden im Park und so was. Da ich jetzt ja nicht mehr in Mainz wohne, ist für mich alles so weggefallen. Und ich habe das beim Karrieren jetzt so berücksichtigt, dass ich gucke, das ich so hälfte, hälfte, einmal mit Corona, wo ich jetzt hingeh und einmal ohne Corona, wo ich früher hingegangen bin.		0					

Figure 3: Paraphrasing text parts (Textstelle) [right arrow] and coding of “in the past” (früher) [down arrow].

## 2.4 Visualization

The next steps included the implementation of the analytical text, the themes, the codes and a polygon of the administrative boundary of Mainz (OpenStreetMap: key value: admin\_level:4) in a map. For that purpose, the software QGIS was applied. Figure 4 shows a Geojson file with the visualized attributes: Codes (“iso”), subjects (“name”), the absolute and percentage of the code (“absolute”, “percent”), the analytical text (“exper”, “struc” and

“struc2”) and a polygon regarding the percentage (“geometry”) of each code. The latter attributes were used to split the polygon of Mainz into a multilayer symbol with five subdivisions regarding the percentage of the respective code. In addition, each part was assigned its own color (see Figure 7 in the results).

```

1 {
2   "type": "FeatureCollection",
3   "name": "wie",
4   "crs": { "type": "name", "properties": { "name": "urn:ogc:def:crs:OGC:1.3:CRS84" } },
5   "features": [
6     { "type": "Feature", "properties": { "iso": "erkundet", "name": "Habe vorher Mainz erkundet", "bereich": "Wie gemappt?", "percent":
7     { "type": "Feature", "properties": { "iso": "zhgesetzt", "name": "Punkte zuhause gesetzt", "bereich": "Wie gemappt?", "percent": "2
8     { "type": "Feature", "properties": { "iso": "zuhause", "name": "Von zuhause auf Mainz projiziert", "bereich": "Wie gemappt?", "per
9     { "type": "Feature", "properties": { "iso": "irueher",
10      "name": "Gemappt aus meinen Erinnerungen an Mainz",
11      "bereich": "Wie gemappt?",
12      "percent": "44",
13      "year": "2021",
14      "absolut": "23",
15      "exper": "Die StudentInnen kartierten zu 44 % ihre Punkte basierend auf ihren <b>früheren
16      "struc": "Während bei diesen Typischen (Orten), (...) man noch ungefähr (wusste), was man n
17      "struc2": "Die StudentInnen wohnen mehrheitlich nicht in Mainz (i2, 5/08; i2, 7/57; i3, 10
18
19   "geometry": { "type": "Polygon", "coordinates": [ [ [ 8.238992148514665, 49.897929849849028 ], [ 8.239549321283247, 49.935013
20 { "type": "Feature", "properties": { "iso": "mainzer", "name": "Ich bin Mainzer, Ich kenn mich hier aus!", "bereich": "Wie gemap
21 }
22 }

```

Figure 4: GeoJSON with polygon and interview text by categories and themes.

### 3. Results

The content analysis provides abstract evidence for the emergence of students’ perceptions of space beyond qualitative and quantitative descriptions of spatial objects. The analysis is extended to the relationship between individual and historical perspectives and structural circumstances that influenced sketch mapping production.

#### 3.1 Transcription

Privacy and 100% offline usability are key advantages of the vosk-api script, as is the ability to adjust the number of words per transcribed paragraph within the script. With the existing hardware configuration, the average execution time from raw material to text was 10 minutes, seems not time-consuming.

```

00:09:22,500 |--> 00:09:33,450¶
könnt ihr euch vorstellen liegt es nur daran dass man da nicht hingehen
darf oder miteinander irgendwie nicht hingehen sollte man z irgendwie
keine ahnung flächen risiko der¶
¶
00:09:22,500 --> 00:09:33,450¶
Interviewer 2: Könnt ihr euch vorstellen, liegt es nur daran, dass man da
nicht hingehen darf oder, dass man irgendwie nicht hingehen sollte, weil
es irgendwie, keine ahnung, ein Risiko darstellt?¶

```

Figure 5: Comparison of good transcription; raw (top) edited transcription (below in red).<sup>5</sup>

<sup>5</sup> Translation Figure 5: Can you imagine, is it just because you’re not allowed to go there or, your kind of shouldn’t go there because it’s kind of, I don’t know, a risk?

However, the overall transcription results were somewhat mixed. While good examples achieved a rate of six spelling errors within 27 transcribed words, poor examples had 21 errors within 27 words (Figure 5 and Figure 6).

```
00:02:03,840 --> 00:02:14,910¶
sie ·war ·bei ·einem ·anfangen, also ·ist ·es ·ja ·auch ·oder ·treffens ·einer ·sind ·
meist ·und ·müssen ·und ·ich ·eine ·ehrliche ·art ·von ·Schwierigkeiten ·zu ·messen ·
staunen ·versetzen¶
¶
00:02:03,840 --> 00:02:14,910¶
StudentIn ·1: ·Ja, ·dann ·kann ·ich ·mal ·anfangen, also ·bin ·ja ·einer ·von ·denen ·
die ·nicht ·in ·Mainz ·gebunden ·sind ·und ·ich ·bin ·ehrlich, ·ich ·hatte ·schon ·
Schwierigkeiten.¶
```

Figure 6: Comparison of bad transcription; raw (top) cleaned up transcription (below in red).<sup>6</sup>

### 3.2 Interview results

97 interview phrases (N) of seven interviews were assigned to nine codes. Two themes emerged from the inductive evaluation: self-experiences (n=52) and structural reasons (n=45).

The theme “self-experience” was dominated by statements about previous experiences in the city of Mainz (23 of n=52), followed by the codes “Mapped at home” (12) and “Projected” from home (10) due to lack of personal knowledge of the city of Mainz. Being a “citizen of Mainz” (4) or the time at which the students had “explored” the city (3) were less important for the mapping process (Table 2).

Table 2: Codes on self-experiences (n=52, N=97)

Codes on self-experiences	Mentions	Example quote (translated by author)
In the Past (früher)	23 (44%)	“That happened before Corona, when I visited Mainz. I also had places where I had already been more often, so I was able to bring that in.”
Projected (von zuhause projiziert)	10 (19%)	“I’ve looked at my current surroundings and thought about what things there might be where improvements would be possible or (...) good, and (...) transferred that (...) to Mainz.”

<sup>6</sup> Translation Figure 6: Yes, so I can start, so I’m one of those who are not tied to Mainz, and I’ll be honest, I’ve had some difficulties.

Mapped at home (zuhause gesetzt)	12 (23%)	“I’ve only been to Mainz three or four times now, if at all, and I simply set them at home, because I had no idea.”
Citizen Mainz (Mainzer)	4 (8%)	“I live in Mainz, so I mapped what I do in my spare time.”
Explored (erkundet)	3 (6%)	“I don’t live in Mainz and then I arranged with (a fellow student) that we walk through Mainz together. (...) look at a few things that are perhaps a bit typical.”
n/N	n=52 (100%)	46% from N

Table 3: Codes on structural reasons (n=45, N=97)

<b>Codes on structural reasons</b>	<b>Mentions</b>	<b>Example quote (translated by author)</b>
Corona	33 (73%)	“I would say on the basis of Corona that people go out in nature more often now because they can also move more freely there (...), they would probably also do more things indoors in winter.”
Society (Gesellschaft)	6 (13%)	“What I didn’t like. (...) the main train station is very noisy, or maybe it’s not so clean. These are typical things that are also found in other cities.”
Freshman (Studienanfänger)	5 (11%)	“And if you’re new to the city, then you’re simply limited in your options.”
Exercise (Übung)	1 (2%)	“So, then I also thought about it for the first time during the exercise, what I don’t really like about Mainz.”
n/N	n=45 (100%)	54% from N

On the theme “structural reasons” during mapping, the following tendency emerged: 33 of n=45 relevant statements referred to the pandemic situation. The fact that the interviewees were “freshmen”<sup>7</sup> (5) correlated with general statements (society) about the main station as a typical dirty place (6). The combination of being a freshman and having little experience in Mainz and only knowing the way to the university might be related to a socio-spatial projection. In this case, a lack of experience is correlated with the discourse of the main station in urban areas, in general (Table 3).

The codes were evenly distributed among the 97 relevant formulations with 54% experiences and 46% structural circumstances. This balance does not seem significant, however, the qualitative analysis (written text on the left) in Figure 7 shows that the mapping is based on both personal experience and structural circumstances, with interactions between the mapping under Corona and the other codes.

Finally, students recalled their past experiences with other students in Mainz. They perceived the pandemic as a current negative event, while they more or less kept memories of positive experiences they had had in Mainz. This shows that how someone sketches depend on relational circumstances that are preceded by a collective group perception of how the space of individually experienced current and past circumstances is perceived.

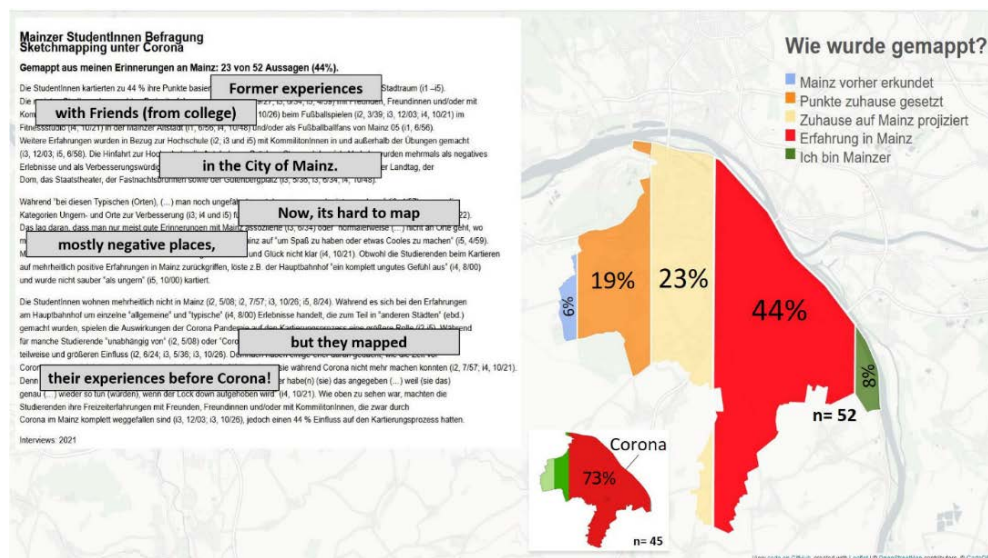


Figure 7: Mapping experiences and circumstances – textual (left) and statistical distribution in percentage (right). Map: Border of Mainz.

<sup>7</sup> First-year student.



#### 4. Conclusion

The qualitative content analysis indicates sketch mapping as a relational process encompassing spatial perception of actual circumstances and past experiences. However, Geoinformatics and Cartography mainly focus on technically clean and comprehensible projections, signatures or generalizations during map production (see Bittner and Michel 2014). Instead, as Harley (1988) emphasizes, maps should be critically deconstructed rather than seen as realistic representations. The content analysis of sketch mapping provided initial empirical evidence that maps are socially constructions derived from individual and structural circumstances. The authors therefore propose further theoretical and methodological research on qualitative content analysis of mapping behavior, not only to identify sketch-mapping patterns, but also to help generating an understanding of mapping production. Considering the relationship of space, place, flow, and connection (Sui and Delyser 2012) embedded in social structures offers guidance.

Indeed, qualitative content analysis is still time-consuming even with the assistance of auto-transcription, and analyses of qualitative content require a great deal of manual effort. However, improvements in accuracy are possible by creating new Vosk-compatible models using the machine learning library Kaldi (Povey 2020). Furthermore, the new [November 2022] open-source speech recognition tool whisper-ai (Open ai 2022) has been trained on 680,000 hours of web and audio data from different languages (German language: 13,344 hours) and produces fundamental improvements (Radford et al. 2022). It also runs on several operating systems and is suitable for use in the workflow presented in this paper (Section 2.2). In addition, the combination of traditional qualitative content analysis with automated text processing methods, such as natural language processing, computational linguistics, and linking to semantic web sources, are promising. Thus, for example, machine learning and tokenization of previously manually generated text patterns could improve coding (Section 2.3.) or provide the analyst with clues about recurring phrases and word segments and their subjectivity to interpret interview results (Section 3.2.). Furthermore, quantitative corpus linguistics can assist in identifying speech patterns, extracting structures inductively from large amounts of data, and deriving new codes (Bubenhofer 2009). Named entity recognizers can complement these methods by systematically identifying toponyms within a corpus so that these patterns can be geolocated and visualized (Section 2.4.) (Bubenhofer 2014). In addition to pattern analysis, code review, and topic explication (Section 2.3.2.), semantic knowledge graph constructions based on Resource Description Frameworks (RDF) (DuCharme 2013) could provide analysts with possible automated explanations from Wikidata helping to find new themes. Retrieving contextual information from heterogeneous, open, linked data sources enables the analysis of group-specific knowledge and social discourse.

Further studies comparing processing time between manual and semi-automatic methods involving a wider range of transcribers, as well as benchmarking of different software for automated speech recognition, could also provide further insights on whether speech recognition can save time in qualitative research, given sufficient quality. However, a fully



automated transcription and coding process would again rather focus on technical clean and coherent representations. Manual steps in the operationalization process remain important, not only to get to know the material better, but also to overcome dichotomies of “accurate and inaccurate, objective and subjective, literal and symbolic” (Harley 1988). Further development of GIScience into an even more interdisciplinary subject can be achieved by taking into account the epistemological foundations of human geography as well as new operationalization’s in information technology.

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# What is Price-influencing in Buyers' View of Residential Property – A Mixed-Method-Approach to Analyse Purchasers' Perspective

## Abstract

In many regions in Germany, housing prices are strongly increasing. It can be assumed that the trend will continue due to various factors (Adolphs et al. 2019). One reason is fluctuating prices due to individual negotiations in the purchase process. Despite standardized valuation procedures with objective approaches, it is regularly observed that buyers often pay prices that deviate significantly from the market value. The question arises as to whether the deviations of the prices from the market value can be better modelled (Süring and Weitkamp 2020).

A mixed-method approach is used to present the buyer's perspective to show which further criteria could explain this difference and shows what is price-influencing for buyers of real estate. Major factors for the buyers' group (both self-used and non-self-used residential real estate buyers) are location, building renovation condition and available living space. The findings of a pre-study will be presented in the following paper. As the result of the paper, hypotheses are derived and the design of a main study is developed. It is expected, that the foreseen results will increase market transparency and will minimize the gap between the determined real estate value and the purchase price.

## 1. State of the research on buyer behaviour in the real estate market

International literature research in the field of real estate transactions was conducted. Individual case studies on this topic are mainly in the Asian region. The literature research has shown that there are already some studies on buyer behaviour (Süring and Weitkamp 2020). The studies often deal with factors influencing deciding whether to purchase a property. Buyers consider factors such as location and environmental factors, quiet neighbourhood, sense of security, financing options, developers and amenities (Mydhili and Dadhabai 2019; Thaker and Sakaran 2016; Wijayaningtyas et al. 2015; Zróbek et al. 2015).

There is also research on factors that influence the price/value of a property. For example, factors such as flood risk, traffic noise, emissions, and distance to various amenities can have both positive and negative effects on property value (Belanger and Bourdeau-Brien 2018; Eves and Blake 2015; Mesthrige and Poon 2015). Another study focuses on buyer types

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(investors, private owners) and asks whether certain buyer groups systematically pay different prices (Larsen 2010).

The literature review showed that studies often look at the “price” and “value” of residential real estate (see Chapter 2 for an explanation of the terms). One study indicates that homeowners tend to overestimate the value of their property when the actual value falls below the home’s purchase price (Cruijssen et al. 2018).

These studies start from the decision-making process of real estate purchase, which is quite different from the approach of this study. In addition, the studies refer to specific areas of research in a particular country, which have no general validity for other countries. There are only a few studies for Germany in factual and spatial areas that show which factors influence the price of a property. For Germany, it can be observed that prices and values for residential real estate often diverge from each other. The investigation of which criteria could explain the spread between the price and value of a residential property could have a scientific added value for the German property valuation (Süring and Weitkamp 2020).

## 2. The difference between price and value in the housing market

The real estate market is heterogeneous. It is diverse because of the many different submarkets and the various types of real estate. There is also a variety within each type in terms of equipment. Moreover, it is due to the numerous stakeholders in the real estate market. The stakeholders comprise both experts and laypersons. The individual perspectives of people, the levels of knowledge and the information sources lead to deviating personal and subjective value perceptions (Kleiber et al. 2020). The housing market, in particular, is characterised by a high number of lay people, the majority of whom are small private owners or owner-occupiers (GdW 2019).

One of the objectives of real estate appraisal is to create higher market transparency to handle this heterogeneity. Like in a lot of countries, in Germany, well-established standardized valuation methods are used to determine a market value: there are the comparison approach, the income approach and the cost approach. The market value is determined based on the actual characteristics, the condition and the location of the property as well as other valuation objects that are relevant to the value (Kleiber et al. 2020). The valuation is carried out objectively according to the definition from the federal building code (BauGB). Personal opinions or feelings do not influence the value of the property; a strict distinction is made here from the “price”. Thus, the “value” objectively describes the quality of a thing. As soon as subjective aspects are included in the consideration and individual negotiations between buyer and seller take place, experts speak of a “price”. Thus, the “value” of a property normally differs from the “price” (Friedrichsen 2021). The spread between “price” and “value” can regularly be found in market observations and is confirmed by initial investigations in interviews (see below).

An example from Brunswick (Lower Saxony, Germany) shows the dispersion around a median purchase price, which can be interpreted as market value (Figure 1). 155 purchase

cases from Brunswick from the year 2022 show a dispersion of about  $\pm 760$  EUR/m<sup>2</sup> around a mean purchase price.

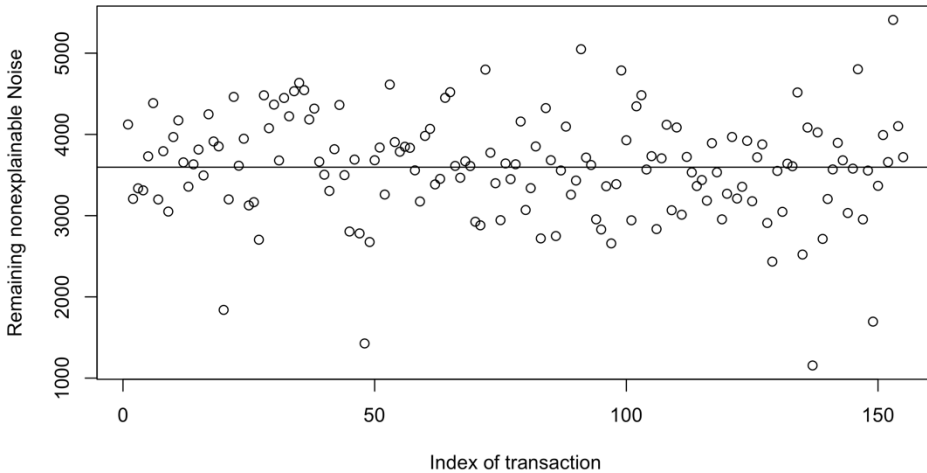


Figure 1: Dispersion of purchase prices (own illustration).

In evaluation practice, the dispersion of purchase prices around a market value is assumed to be normally distributed, which justifies the use of (multiple) linear regression analyses. However, there is a well-founded assumption that the market value has an asymmetric uncertainty distribution: In a lay survey on the assessment of market value, Soot (2021) was able to demonstrate that a large sample of surveyed laypersons estimated the value in a right-skewed manner. In practice, this is usually compensated for by trimming the sample so that only an approximately normal distribution is evaluated – with the consequence that no statements can be made at the edges of the distribution (Zaddach 2016).

The research aim is to model a part of this dispersion by integrating the buyer's perspective. This should give insight into which further criteria can explain the difference or which criteria already exist and are used to evaluate market values should be weighted differently, if necessary (Süring and Weitkamp 2020).

Therefore, this paper focuses on the design of a mixed-method approach for a survey with buyers of self-used and non-self-used residential real estate. The results of a qualitative preliminary study are shown together with the derived hypotheses, which are used to develop a quantitative survey. The investigations shall answer the question:

*Which parameters are relevant for buyers when purchasing real estate and the amount of the price paid?*



### 3. Research design of the Mixed-Method Approach

The research design essentially comprises five different steps (Fig. 2) and contains as core elements a mixed-method approach consisting of a qualitative pre-study and a quantitative main study with buyers. The results from the qualitative pre-study are incorporated into the main study. This paper focuses on the presentation of the methodological approach and draws an interim conclusion on the pre-study. This is followed by developing the design of the main study.

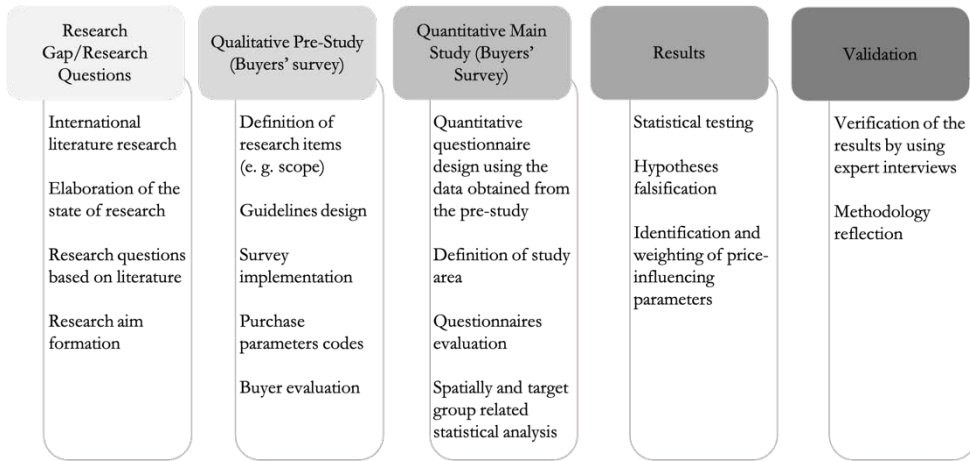


Figure 2: Research design of the qualitative study (own illustration).

#### 3.1 Design of the qualitative pre-study

For the qualitative pre-study, only natural persons participated. The property should have been purchased within the previous 5 years. The 5-year period results primarily from the following assumption: distortions of impressions and memories increase the longer the event occurred in the past. Participants with an underlying wide age range are interviewed. Relevant self-used and non-self-used residential properties are condominiums, single-family houses, duplexes, semi-detached houses and townhouses. The analysis only includes buyers' statements of existing properties that were older than three years. New construction properties have the advantage over existing properties in that the buyer is more likely to be able to influence the construction. In the case of existing properties, the weighing process between individual properties is higher, which makes the derivation of the priority of individual (price-influencing) parameters more promising (Brückner 2016).

The qualitative study is conducted as a guided interview. There are different guides for the two submarkets of self-used and non-self-used residential real estate. It can be assumed that the target groups differ in their buying behaviour. The guides are divided into five thematic sections: (1) Classification of ownership and housing situation before purchase, (2) Reasons for willingness to purchase a residential property, (3) Selection process and viewing,

(4) Potential price-influencing parameters, and (5) Additional information about the selected property and personal questions. The questions within the topic sections vary.

A qualitative pretest is conducted before the interviews are held. This type of pretest focuses on checking comprehensibility (Döring & Bortz 2016). Here it is noticeable that buyers repeat themselves strongly in answering some questions. A renewed adjustment with a subsequent pretest enables a significantly higher gain in knowledge, as indicated by the evaluation of the interviews.

The interviews end when theoretical saturation is achieved. When the interviews produce minor to no new information, this is defined as an appropriate level of participants in the survey. This is done knowing that the saturation is presenting a local and not an absolute maximum of information. Against the background of the prior knowledge from the literature research, this risk is manageable (Döring & Bortz 2016). For self-used residential properties, saturation occurs after 21 interviews and for non-self-used residential properties, saturation occurs after 10 interviews.

Content analyses allow the evaluation of qualitative interviews. The analysis procedures according to Mayring and Kuckartz are widely used. While Mayring suggests a structured theory-based procedure, Kuckartz prefers the further development of the categories in the editing process (Schreier 2014). For the buyer survey of self-used residential properties, the recorded audio files are transcribed and computer-assisted evaluated by MAXQDA. The initial superordinate codes emerged deductively from the guides (Kuckartz 2010). The lower-order codes are obtained inductively by working through the material. As suggested by Kuckartz (2010), the code system will be adapted and further developed after initial transcripts have been processed. Since the answers of the interviews with buyers of non-self-used residential real estate are already compiled on the guides, the evaluation is done via Excel with the formation of codes derived from the questions (deductive) and the formation of codes from the answers of the interviewees (inductive).

### 3.2 Design of the quantitative main study

The main study also addresses natural persons. Buyers are to be reached via expert committees. Expert committees send a questionnaire to every buyer for their data collection, as German law obliges the buyers to provide information to the expert committees. The call (using a flyer) for participation in the main study is to be distributed by the expert committees when they send out their questionnaires. The main study is aimed at buyers of the following types of real estate: condominiums, semi-detached houses, townhouses, single-family houses, and duplexes. The type of use of real estate can be both self-used and non-self-used.

Content-related explanations of the concept follow in chapter 4 by deriving hypotheses from the results of the preliminary study in chapter 3.

## 4. Summary of the qualitative findings

### 4.1 Buying intention

The reasons for buying real estate vary among buyers of self-used residential real estate. In contrast, the picture is clearer in the segment of non-self-used residential real estate: Here, the focus is on acquisition as a hedge in old age (retirement provision) or as an investment. Figure 3 summarizes the main reasons for the willingness to buy self-used and non-self-used residential real estate by contrasting them.

Buyer of self-used residential properties	Buyer of non-self-used residential properties
<ul style="list-style-type: none"> <li>• Investment/hedging as retirement provision</li> <li>• Family enlargement</li> <li>• Expansion of living space</li> <li>• Desire for ownership and individual design</li> <li>• Urgency/Compulsion</li> <li>• Availability of a good offer</li> </ul>	<ul style="list-style-type: none"> <li>• Investment/hedging as retirement provision</li> </ul>

Figure 3: Summary of reasons to buy real estate (own illustration).

In the self-use segment, residential real estate is frequently acquired due to family enlargement. Closely connected with family enlargement is also the desire for spatial expansion. Another reason is the desire to own property. Often, these respondents mention as additional information that they already grew up in an owner-occupied home of their parents and can therefore identify with the idea of owning their property. The design possibilities of ownership are rated significantly higher than in rental properties. In a few cases, respondents decided to purchase a residential property out of urgency or necessity: these manifest as challenges between tenant and renting and a change of residence due to a changing life situation. Another reason is the availability of a good supply (Süring et al. 2023).

### 4.2 Potential price influencing parameters

During the interviews, many buyers clarify which criteria are essential (indispensable criteria). Properties are eliminated due to lack of availability or due to the lack of personally important criteria. Finally, the weighting of the prioritized criteria leads to the purchase decision and reflects the previously set claims.

The interviews reveal numerous criteria that are used in the process of selecting a residential property. For both self-used and non-self-used buyers, the renovation condition of the property plays a role. Buyers of non-self-used real estate prefer smaller condominiums in the city centre close to the university. When choosing a property, the focus is on good rentability and good return opportunities. In the self-used segment, buyers prioritize properties with large living spaces in locations with good accessibility in terms of workplaces, educational institutions and public services. Thus, location can be confirmed as a key criterion in all purchase decisions.

Proximity to family members and a family-friendly location also play a role in the choice of location. Buyers prefer neighbourhoods where they “feel” they live in a quiet location. Locations are considered as quiet if the property is not located directly on a main road, but on a road with less traffic and good accessibility. Accessibility refers on the one hand to transport infrastructure links, and on the other hand to the accessibility of certain facilities and places. Figure 4 provides an overview of the main factors mentioned concerning accessibility.

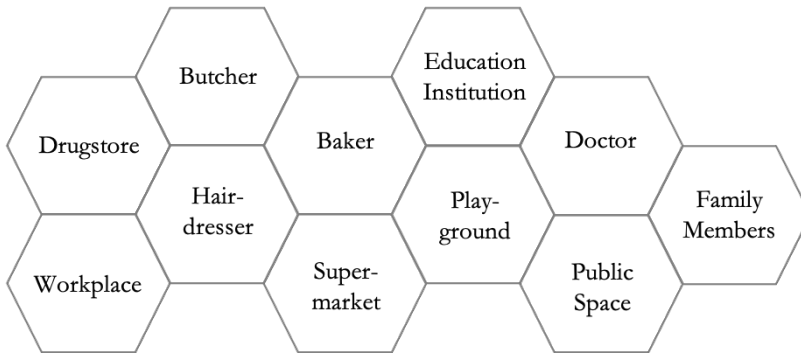


Figure 4: Identified parameters regarding the accessibility of important locations (own illustration).

However, it should be noted that the criteria mentioned are based exclusively on the personal (subjective) understanding of the respondents. This certainly differs from existing definitions.

Both buyers of self-used and non-self-used residential properties were asked if they would be willing to pay more for a property if they would get the indispensable criteria by doing so. All interviewees would pay more. It can be hypothesized that there is a willingness to pay more to achieve an individual's residential real estate desire. Whether more than the required price was paid for the property purchased was not part of the survey, but will become part of a further quantitative investigation (Süring et al. 2023).

#### 4.3 Buyer groups' market knowledge

Most of the interviewees mentioned that no market value appraisal was made for the purchase of the real estate. On the one hand, information is obtained via real estate portals and on the other hand via credit institutions. Buyers use real estate portals to find out about price trends in the residential real estate market. In addition, buyers look for comparable offers in the surrounding area and compare these prices. Frequently also standard land values are consulted. Besides, as part of the clarification of funding, credit institutions usually check whether the risk is reasonable for their company and decide whether or not to grant a loan. This statement of the credit institutions is usually sufficient for the buyers. Brokers are rarely entrusted with the search for potential properties but are commissioned by sellers.

The perception regarding the appropriateness of the price varies. The interviewees more frequently think that high prices are currently demanded on the market and that this fact must be met. The interviewees often see no other possibility to pay the demanded price to be able to fulfil the desire of owning a property.

The non-self-used buyers focus on rentability and management by external parties. Students looking for housing presumably contribute here to the good rentability of the mostly small apartments. Buyers of non-owner-occupied residential real estate usually enlist the help of investment advisors and brokers in finding the right property. Although only two of the 10 respondents live more than 100 km from the location of the acquired property, eight stated in the interviews that they had commissioned external parties to manage the property. In further research, the focus will be on the aspect of financing and the expected return on investment (Süring et al. 2023).

#### 4.4 Interim conclusion of the qualitative pre-study

In the context of location, accessibility in particular has a significant influence. For this reason, further studies should also take a closer look and focus on the individual interpretation of location. This finding from the surveys can also be demonstrated in empirical studies (Ortner et al. 2023). The study was able to clarify which parameters are included in the purchase and that buyers are willing to pay more to obtain the desired criteria.

Buyers often have the opinion that real estate is currently overpriced anyway and that this should be accepted for the purchased property. Public media and the availability of real estate valuation tools have an impact on buyer perceptions. This is also due to the online marketing of properties, where there is easy access to prices in the form of asking prices. There is a lack of knowledge about the difference between asking prices in online marketing platforms and actual market values. After all, there can be a difference between these two terms (price and value). It can be assumed that the media presence and the availability of online tools lead to higher price expectations also on the part of buyers. This can even be demonstrated among real estate experts (Diaz 1997).

It can be seen that the respondents are mostly satisfied with their purchasing decisions. Purchasers mainly describe that they had to make few or no compromises, but that they still paid an appropriate price. It can be assumed that in the case of a decision as relevant as the purchase of a property, the purchase decision is evaluated more positively afterwards. Doubts that still existed in the process faded out after the decision (Pfister et al. 2017; Pieters et al. 2006).

At the time of the qualitative survey in the period from 2020 to 2021, the issue around energy requirements (relevance of ancillary costs) did not yet play a significant role, as energy prices were stable up to this point. It can be assumed that greater importance will be attached to this topic at present; thus, this aspect will also find its way into the following quantitative survey.

## 5. Deriving hypotheses from the pre-study

The pre-study has shown which parameters are taken into account in the purchase decision and that buyers are also prepared to pay more for their desired property. The main quantitative study is intended to identify which concrete parameters influence the price for buyers. For this purpose, hypotheses are derived from the results of the qualitative study. Subsequently, quantitative questionnaires for buyers of self-used and non-self-used residential properties will be designed.

Based on the results of the pre-study, the following categories can be derived: (1) overall property (2) location (3) maintenance and equipment (4) area of land/living space (5) perception of value and (6) expected return.

### Hypotheses of the overall property

To get the desired criteria, buyers seem willing to pay more. There is an assumption that the majority of buyers of self-used residential real estate have adjusted the requirements to the desired real estate in the course of the purchase process. In contrast, the majority of buyers of non-self-used residential real estate make only minor adjustments to the requirements of the desired property. Because buyers of non-self-used residential properties involve real estate brokers early in the purchase process, there are fewer adjustments needed. In addition, different types of real estate have different price levels.

The quantitative survey, therefore, highlights the issues of different approaches to the buying process and adjustments in the overall process. It is assumed that differences exist in the buyer groups and spatial submarkets.

### Hypotheses of the location

It is expected that location is the most price-influencing parameter for buyers of self-used residential real estate. This parameter is often weighted higher than the equipment parameters. However, the individual location parameters will also show differences in price formation for the different buyer groups (in different life phases). For this purpose, it is further assumed that for buyers in different life phases, proximity to the immediate family circle is weighted differently as a price-influencing parameter. Good transport links (to public transport and the freeway) to towns and villages with further/higher-quality public services (doctors, bakers, etc.) also influence the price of a property. For buyers of non-self-used residential properties, the focus seems on purchasing a property in an (e.g. university) town with a central location and good public transport links. For most buyers of all ages, the personal perception of having chosen a property in a "quiet location" appears to have a price-influencing effect.

The quantitative survey will take an in-depth look at the topics of the individual location parameters and for which groups of buyers which location parameters are particularly important. It is presumed that differences in the buyer groups can also be shown here.

### Hypotheses of the maintenance and equipment

According to the qualitative pre-study, another important aspect is the maintenance of the building. Therefore, it is expected that for the majority of buyers, the maintenance condition is a price-influencing parameter, whereby the individual maintenance parameters show differences in price formation.

The quantitative survey will therefore deal with the subjects of whether the chosen maintenance condition of the property depends on the income of the buyers. Besides, it will be surveyed to what extent the degree of modernization of a residential property is both a value-determining parameter in property valuation and a price-determining parameter from the buyer's perspective.

### Hypotheses of the land- and living space

Concerning space, it should indicate whether the available living space is a price-influencing parameter for the majority of buyers. Presumably, for residential properties which need extensive renovation, the number of rooms seems not to be a price-influencing parameter and the possibility of subsequent adjustments (such as room layout) weighs more importantly. The number of rooms appears more price-influencing for those buyers who are looking for a residential property that is ready for occupancy. The majority of buyers seem to set a minimum requirement for living space and lot area at the beginning of the buying process. The majority of buyers seem not to go below the minimum requirement.

The quantitative survey will therefore check whether, in tighter housing markets, buyers of self-used residential properties deviated from either the original property type or the original lot size during the purchase process. In addition, the survey investigates the differences between the individual buyer groups in terms of their expectations regarding the required square metres of living space.

### Hypotheses of the value perception

Noticeable in the qualitative pre-study was the statement that in some cases reductions were made in the desired criteria, but the price was still perceived as reasonable. This leads to the hypothesis that very few buyers adjust the price level of the property downwards despite making concessions in the desired criteria. Most buyers of self-used residential properties seem to have no current market value appraisal available. The majority of the buyers think that an appropriate price was paid, which is derived from the current market situation. Most buyers appear to deviate more than 20% from their previously set budget in the price paid.

The quantitative survey will address the fields of buyers' price perceptions. To this purpose, buyers are asked to indicate whether they have deviated from the originally selected budget. In combination with the earlier surveyed adjustments and deviations within the purchasing process, it can once again be shown more clearly which parameters had an impact on the price.



### Hypotheses of the expected return

The pre-study show that buyers of non-self-used residential real estate select properties more frequently via real estate brokers than buyers of self-used residential real estate. For the main study, it is assumed that the majority of buyers of self-used housing conduct independent searches for their desired property. For most buyers of non-self-used residential real estate, the focus appears to be on the profitability of the property. Most buyers do not deviate more than 20% from their previously set budget in the actual price paid.

The quantitative survey addresses the issue of rentability exclusively among non-self-used buyers. The parameters of rentability are given different values in the buyer groups considered.

## 6. Conclusion and further work

The quantitative survey will focus in greater depth on the parameters for which consumers would have been prepared to pay a higher price. To this end, it must first be investigated whether a systematization or grouping of the above-mentioned parameters with price influence can be carried out to then be able to ask more specifically about the higher prices.

It shall be worked out which of the parameters mentioned influence the price. The focus will be on the weighting (importance) of individual parameters and the price influence that could be associated with this importance. These findings will make a further contribution to market transparency, as better modelling of the market can be expected with their knowledge.

The questionnaire results from the findings of the qualitative pre-study and consists of eight thematic blocks (cf. Fig. 5).

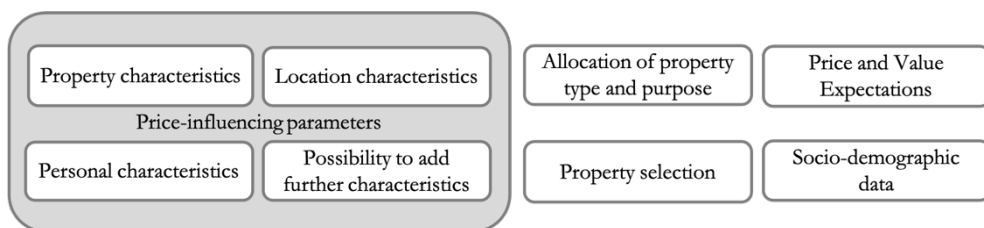


Figure 5: Subjects of the quantitative questionnaire (own illustration).

The questionnaire includes about 30 questions, some of which are filter questions so that each respondent is only asked about things that are relevant to them. The time duration of the questionnaire should be between 20 to 30 minutes, which is to be verified in a pretest. Depending on the question background, the question types vary from open questions to close ones in the form of single-choice/multiple-choice questions with sliders.

Both different functional and spatial submarkets are considered. In the functional submarket, buyers of self-used and non-self-used residential real estate (condominium,

single-family house, two-family house, semi-detached house, terraced house) are addressed. The spatial submarkets are dependent on the willingness of the expert committees to cooperate. The more expert committees participate, the more survey areas result.

The approach follows the sampling strategy of 3 steps:

1. Investigation of all expert committees in Germany (incl. contact data)
2. Contacting all expert committees with the request for support in distributing the questionnaires.
3. After receiving the willingness to cooperate from the expert committees, send out the materials (flyer with QR code for the online survey)

Whenever the expert committees send out their own questionnaires for data collection, they should include the flyer for the survey of price-influencing parameters. The duration of the survey is conditioned by the statistical evaluability of the data and is estimated at about one year. If individual expert committees prefer shorter periods, the length of the survey may have to be adapted to the willingness to participate. The survey is designed as an online survey and focuses on price-influencing parameters in residential real estate purchases. The quality of the survey should meet the scientific requirements for the quality of a qualitative study according to Döring & Bortz (2016).

The survey aims to obtain mathematical-static statements on the significant price-influencing parameters from the buyer's perspective. In particular, it should be highlighted whether there are dependencies in the response behaviour with regard e.g., to age groups, lifestyles or spatial submarkets.

The overall research objective is to determine which parameters define the market value through the standardized market value assessment. This can be derived from different literature.

Furthermore, it is to be examined which parameters have a pricing effect on the buyers. This can be derived from the surveys. Subsequently, it can be shown where differences in approaches exist. Thus, in the best case, the residual dispersion between the price paid and the market value resulting from the valuation can be shown.

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# Propensity Score Matching and Difference-in-Differences Estimator to Assess the Effects of Land Readjustment Projects in Denpasar–Indonesia

## Abstract

The present research aims to assess the impacts of land readjustment in Denpasar, Indonesia, utilizing spatial data processing, sample unit matching, and the difference-in-differences estimator. This study aims to investigate the presence of disparities in property prices between areas that have undergone urbanization through land readjustment compared to areas that have experienced urbanization without such intervention; yet, with comparable attributes, including equivalent urbanization timelines and proximity to the central business district. The analysis was made on two different levels, (1) the whole city, and (2) per project area; moreover, multivariate regression analysis described the relationship between independent variables to the dependent one (i.e., deflated price per square meter). Buffer analysis to address the average effect was carried out at 50 meters for spillover exclusion areas and 1,200 meters for control areas. As a result, the treatment impact of land readjustment projects over the selling prices of properties in Denpasar is 5,462,000 Rp. per square meter (or US\$ 400 per square meter) (as of 2017). That means, on average, properties located inside land readjustment project areas are likely to be worth US\$ 400 per square meter more when compared to other urban areas. When evaluating projects individually, eight out of eighteen projects were statistically significant, and the treatment effect on average ranged from US\$ 280 to US\$ 550 per square meter (as of 2017). The fact that higher property values have concentrated in areas that have undergone land readjustment suggests that these projects have been successful in improving the economic conditions of these areas in the long run.

## 1. Introduction

### 1.1 Purpose

Land readjustment is a legally binding instrument used to reorganize property ownership and increase public spaces. Organized by the government or implementation agencies, land owners are requested to contribute part of their land in exchange for registration and provision of infrastructure. Landowners are willing to bear the project expenses through land contributions driven by various factors, one of which is the probable rise in their net property value followed by the urbanization process (Acharya 1988). Hence, the current research aims to assess the effects of land readjustment in Denpasar, Indonesia, employing spatial data

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processing, sample unit matching, and the difference-in-differences estimator. Difference-in-differences estimator is a common strategy for evaluating the effects of policies or programs instituted at a particular point in time, such as implementing land readjustment projects. The estimator compares changes over time in a group unaffected by the planning instrument to the changes over time in a group affected by the planning instrument, and attributes the ‘difference-in-differences’ to its effects. This study aims to investigate the presence of disparities in land prices between areas that have undergone urbanization through land readjustment compared to areas that have experienced urbanization without such intervention; yet, with comparable attributes, including equivalent urbanization timelines and proximity to the central business district. Difference-in-differences estimator provides unbiased effect estimates if the trend over time would have been the same between the urban intervention and comparison groups in the absence of the urban intervention. However, a concern with the estimator is that the program and urban intervention groups may differ in ways that would affect their trends over time, or their compositions may change over time; the reason why propensity score matching will support unbiased effect estimates. Propensity score matching is commonly used to handle this type of confounding in other non-experimental studies, by using statistical techniques to construct a control group by matching each treated unit with a non-treated unit of similar characteristics. In sum, disparities in variables will be assessed and tested in the city of Denpasar aiming for consistent evaluation of land readjustment implementation and practices.

## 1.2 Land readjustment in Denpasar

The process of adapting land readjustment in Indonesia – referred to as *konsolidasi tanah* or land consolidation – started as a means to transition from the traditional and customary *Adat law* system of land ownership and certification to newly established laws and regulations. The term *Adat law* has been adopted in Indonesia to describe “native law and custom” and refers to a social organization classified into distinct types of independent legal communities (Gluckman 1949). These autonomous communities are grouped in villages and scattered over districts, and their members follow “native law and custom” in relation to each other and outsiders. Certain commonalities exist among these groups, including a differentiation between earned property and inherited property. The earner may freely dispose of the former but not the latter, whereas inherited property is regarded as family property and is subject to different rules. Additionally, community leaders have the authority to shorten the utilization period of earned land for redistribution purposes and reassigned unused land to individuals without land (Arens 1949). The transfer intends to stress that all community members have a portion of arable land, which is a right part of the community’s obligations to all its members. When a person cultivates a specific piece of land, it establishes a relationship known as the “native right of possession” and derogates the “right of disposal” according to the *Adat law*. This “native right of possession” differs significantly from the rights termed “usufruct” or “use” in more advanced legal systems. Thus, landholding in *Adat law* is “held in the hierarchical organization of the society, and an estate-holder must allot land within his estate to his dependents who have a

corresponding right to claim land from him” (Gluckman 1949, p. 64). Community leaders are responsible for dividing land into estates. Primary landholders allocate secondary land estates to secondary landholders, who in turn assign tertiary land estates to tertiary landholders, and so on. All these estates may exist on the same parcel of land at the same time. Therefore, *Adat law* has conflicting implications and, in some situations, becomes the trigger for certain kinds of problems. These complications might encompass land ownership, land transactions, changes in status, and the resolution of disputes related to land.

In recent decades, the Indonesian government has taken steps to formalize customary land rights through land readjustment initiatives. This process of formalization is important because it establishes the legal validity of land titles, thereby affording rights holders legal assurance and certainty (Simarmata 2019). In the given context, the Directorate General Agraria of the former Ministry of Home Affairs and the administrative personnel responsible for the Province of Bali selected a specific area to initiate the inaugural land readjustment project within Denpasar. This designated project area was situated within the Renon area, encompassing the Sumerta Kelod village as well as the Renon and Panjer villages, a decision that was made back in 1982. Historically, these areas were considered satellite areas of the city and were primarily renowned for their agricultural rice production. The primary goal of this project, however, was to develop the agricultural land into a residential neighborhood near to the newly constructed provincial government buildings (Putra 1993). Therefore, readjusting land for the first time in Indonesia combined the legal entitlements of customary land rights and the goal of preventing unplanned urban growth near the established regional administrative zone (Kusumadewa 1985).

Formal requisition for land contribution for cost recovery land was legally impossible back in the 1980s when Renon started to be planned (Dharmawan 1989). Thus, the early land readjustment model executed by the Bali government was fully subsidized without selling cost recovery land. This decision eventually established a path-dependent scenario that remains unaltered within Denpasar to this day. In Japan, for instance, when property owners contribute with private land to increase public land, they also contribute additionally to amalgamate shares in cost recovery land; that is land to be sold to the market to pay back project costs. Since 1991, the Indonesian regulation number 4 of the National Land Agency has permitted the utilization of cost recovery land. However, although a substantial increase in land prices would have enabled landowners to relinquish an extra portion of their land for cost recovery land, a significant proportion of landowners strongly opposed it. Apparently, some landowners prioritize the preservation of their land area over its market valuation, even though the land readjustment pilot project in Renon dramatically pushed up the price of land after its implementation (Kusumadewa 1985, Putra 1993). This benefit also manifested in subsequent projects. However, persuading landowners to provide for cost recovery land remained an unsuccessful task. Landowners, whose land parcels were earmarked for public facilities, were obliged to accept alternative plots, often located at a considerable distance from their original and ancestral holdings. A possible introduction of cost recovery land would further complicate this matter due to the spatial disparity and the



emotional attachment that individuals have to their entitled land parcels (Kusumadewa 1985). Despite the existence of a well-established *Adat law* land-swapping tradition, which aligns with the ongoing international advocacy for land readjustment, landowners in Denpasar – particularly within marginal agricultural communities – prefer uncomplicated land readjustment schemes. These schemes entail minimal land reduction, involve fewer alterations, and entail less extensive infrastructure development (Harun 1998).

### 1.3 Literature review

Literature on land readjustment in the English language has been around since the early 1980s (Doebele 1982). A literature review of journal articles expresses two main groups of studies (Yilmaz et al. 2015; Gielen and Mualam 2019). The first group focuses on independent variables, those variables in an experimental study to explore land readjustment causes. For example, while some studies identified the size of the development area, the number of property owners, and the size of cadastral parcels as determinants of project success, others identified these variables as less relevant when land readjustment is compulsorily carried out (Yilmaz et al. 2015). Other studies attempt to ‘blame’ cultural and institutional factors as responsible for its failed implementation, such as the distrust between property owners and local governments, lack of transparent appraisal methods, and a planning system poorly backed up by cadastral records (Almeida et al. 2018; Condessa et al. 2018). Some of these factors seem to be the rule not an exception, even in countries where land readjustment is considered successful, especially when its implementation is reviewed since its far early stage.

The second group of studies focuses on dependent variables that represent the effects of land readjustment. For example, some studies attempt to expose ecological performance (Kresse and Van Der Krabben 2021), expenditure on school lands (Uzun and Simsek 2018), control of urban sprawl (Sorensen 1999), and displacement conflicts (Colak and Memisoglu 2019) as land readjustment overall results. However, these studies face several methodological challenges. Quite often, the studied dependent variables are not the immediate results of land readjustment, but rather the product of interaction between the planning instrument and other phenomena – such as property rights regimes, economic trends, and government policies. In sum, both groups tend to leapfrog over an in-depth analysis of crucial variables, and thus it remains questionable whether they help to evaluate comparatively land readjustment (Gielen and Mualam 2019). On top of that, it is common to find researchers evaluating existing local planning conditions followed by the presentation of ‘wishful thinking’ on which model of land readjustment should be adopted, which reforms should be performed if already adopted, and how land readjustment should perform if reformed that way (Almeida et al. 2018; Holtslag-Broekhof 2018; Delgado and Scheers 2021).

It is quite challenging to evaluate the efficiency or expose a replicable effect of land readjustment while identifying causalities; not only because exclusive quantitative data about projects seems to be very limited throughout studied research papers, but also because existing studies have been published without analyzing consistent data. Therefore, our literature review reinforced that the research focus on land readjustment should address the

complexity of causalities with data before and after projects' implementation, and other related crucial variables.

## 2. Methodology

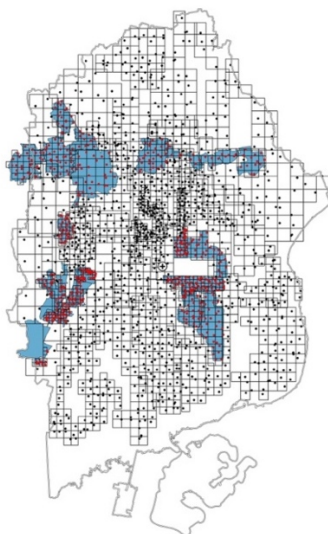
### 2.1 Data collection and processing

The methodology employed in this study relies on the collection and analysis of both, primary and secondary data sources. Secondary data was sourced from a master's degree thesis dating back to the 1990s. The primary focus of the master's degree thesis was to elucidate the factors influencing land price formation during that decade in Denpasar. The investigation was centered on independent variables, such as road width in proximity to the properties, road pavement conditions, and the uniformity of land plots (Haryoto 1997). This source provided valuable yet limited information regarding land prices. In the present research study, we extended our focus and encompassed data collection from the entirety of Denpasar, including data from eighteen land readjustment projects.

The employed sampling strategy was the random clustered method (Smith, Goodchild, and Longley 2015). Under this approach, the targeted research area is divided into larger segments based on the required number of sampling units for achieving the research objectives. Within each segment, a single point is allocated randomly. This method outperforms both regular and entirely random sampling techniques for several reasons. Regular sampling can introduce bias due to its alignment with certain data patterns and may lose information about distance-related effects. Entirely random sampling, on the other hand, may unintentionally exclude crucial areas from the research study. To address these challenges, the random clustered sampling approach was utilized, which combines the advantages of both regular sampling and entirely random sampling methods. Once this strategy was determined to be the most suitable, we implemented the spatial distribution of sampling points across Denpasar using GIS software (see Figure 1).

During the spatial distribution process, specific public spaces, such as ring roads, parks, and government facilities were deliberately excluded from consideration. As a result, these exclusions account for the presence of certain gaps in the distribution of sampling points. With the list of tentative geographical points, the surveyors addressed 2,386 properties with a questionnaire asking the following questions: "What is the actual number of family members inside the property? What is the estimated area in square meters of your land and building? What is the actual transaction price (market value) of your land and your building, in your opinion?" In addition, the following questions were asked to acquire past data: "When did you buy your property, and for how much? Did you buy the land without any construction on it?" Subsequently, a dataset of land prices for the years 1970, 1980, 1990, 2000, and 2017 was compiled. The dataset is the result of the information gathered throughout all questionnaire surveys (2,386) adding the small sample size (66) from the mentioned master's degree thesis. No official statistical data was made available related to property transactions in Denpasar. Importantly, Indonesia experienced the Asian financial

crisis in 1997, which led to a reduction in infrastructure investment and a decreased supply of urbanized land in a scenario of substantial migration and heightened demand. To account for these macroeconomic externalities and fluctuations in the Indonesian currency (rupiah, Rp), all of the price data was adjusted to 2017 values using the Indonesian Consumer Price Index (IDCPI, *Badan Pusat Statistik*) (1 US\$ = 13,500 Rp).



*Figure 1: Clustered Sampling Process and Sample Distribution in Denpasar. (Note: Blue areas are land readjustment project areas).*

## 2.2 Multivariate analysis and propensity core matching

The purpose of incorporating the multivariate analysis was to identify the variables that would exert either a positive or negative average influence on land prices. However, it will not elucidate the causal relationship between land readjustment and adjusted selling prices of land. The validation of causality will be subsequently achieved through the described randomized experiment, followed by the process of unit matching and the application of the difference-in-differences estimator; alongside, the difference-in-differences estimator will be verified with the prerequisite of the parallel trends' assumptions to effectively isolate the impacts of land readjustment on adjusted selling prices of land (Duflo et al. 2006). Propensity score matching is a model to estimate the probability/propensity that a study unit from the 'control group' that has not received the intervention (i.e., the property is not a participant of a land readjustment project) is similar at baseline to another unit from the 'treatment group' (i.e., the property is a participant of a land readjustment project) based on a set of key characteristics (De Vocht et al. 2016). It will be used in a logit regression where the dependent variable is a dummy variable expressing whether the property was part of one of the eighteen projects in Denpasar. For matching, propensity scores, defined as the

probability that a property  $n$  was part of a land readjustment project, are formulated using a logit model, as follows:

$$\Pr(t_n = 1) = \frac{1}{1 + \exp(-\sum \rho_h s_{nh})} \quad (1)$$

where  $s_{nh}$  is the  $h^{\text{th}}$  explanatory variable for property  $n$  and  $\rho_h$  is an unknown coefficient. For each ‘readjusted’ property, the ‘not-readjusted’ property with the closest propensity score is selected for matching (also known as the ‘nearest neighbor’ concept). Once the matching is complete, an equilibrium analysis is performed to determine if the comparability between the readjusted and not-readjusted property is satisfactory and if no new biases appear. Finally, the average treatment effect on those treated properties is calculated to quantify the treatment impact of land readjustment projects over the adjusted selling prices of land in Denpasar, using the difference-in-differences estimator.

### 2.3 Difference-in-differences estimator

The combination of government incentives and robust economic growth, driven by tourism, has led to a significant increase in urban land prices in Denpasar since the 1990s. The 1997 Asian financial crisis, which caused a loss of confidence and capital outflows, led to currency devaluation and high inflation in Indonesia. This raises concerns about the real increase in land prices after land readjustment projects, given the speculative activities and overlapping externalities. To address these concerns, data was carefully collected to evaluate eighteen land readjustment projects and assess changes in land prices over time. This was done using the difference-in-differences estimator (Duflo et al. 2006). Difference-in-differences is a statistical technique that evaluates the differential effect of a treatment on a ‘treatment group’ (or the land readjustment project area) versus a ‘control group’ (or an area where land readjustment was never implemented) in a natural experiment. It calculates the effect of a treatment (i.e., land readjustment implementation) on an outcome (i.e., the selling price of urbanized land per square meter) by comparing the average change over time in the outcome variable for the ‘treatment group’, compared to the average change over time for the ‘control group’ (see Figure 2).

In addition, difference-in-differences require a parallel trend assumption. The parallel trend assumption states that in the absence of the treatment, the trends of the treated and untreated units would have been parallel. This means that the treated and untreated units would have been changing at the same rate over time, even if they had not been exposed to the treatment. The parallel trend is a key assumption of difference-in-differences analysis, but when it is not met can lead to bias in estimates, such as mean regression, reverse causality, or omitted variable bias. There are several ways to test the parallel trend assumption. One way is to visually inspect the trends of the treated and untreated units over time. If the trends are parallel, then the parallel trend assumption is likely to be met. In sum, only four observations are necessary for the estimation: (i) the model constant, (ii) the year variable, (iii) the treatment dummy, and (iv) the dummy composed of treatment multiplied by time.

$$Y = \beta_0 + \beta_1 * [\text{Time}] + \beta_2 * [\text{Intervention}] + \beta_3 * [\text{Time} * \text{Intervention}] + \varepsilon \quad (2)$$

where  $\beta_0$  is the baseline average,  $\beta_1$  is the time trend in a nontreated group,  $\beta_2$  is the difference pre-intervention, and  $\beta_3$  is the difference in changes over time.

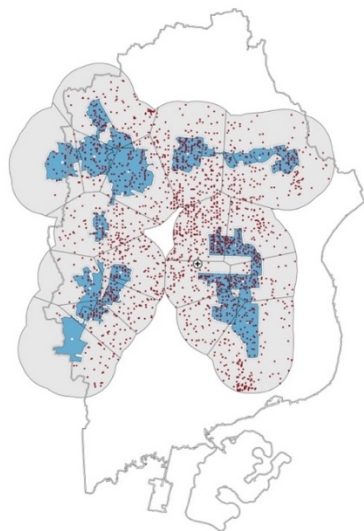


Figure 2: Buffers for (Blue) Treatment Areas and (Grey) Control Areas. (Note: 50 meters for spillover exclusion areas and 1,200 meters for control area).

### 3. Results

#### 3.1 Multivariate analysis

The descriptive statistics of main variables summarized average values including the average selling price for urbanized land as 17,291,632 Rp. per square meter (or US\$ 1,270 per square meter, as of 2017) (see Table 1).

The multivariate analysis has the average selling price for urbanized land as the dependent variable and results in three positive linear relationships and two negative linear relationships (all statistically significant, as of 2017) (see Table 2): (1) for each additional square meter of land area, the average selling price for urbanized land increases by 62,316 Rp. per square meter (or US\$ 5 per square meter); (2) for each additional square meter of built-up area, the average selling price decreases by 83,234 Rp. per square meter (or US\$ 6 per square meter); (3) for each additional floor, the average price increases by 2,093,301 Rp. per square meter (or US\$ 150 per square meter); (4) for each additional meter of distance to the central business district (CBD), the average price decreases by 1,448 Rp. per square meter (or US\$ 0.11 per square meter); and (5) if the road facing the property is paved, the average price increases by 4,722,381 Rp. per square meter, if compared to access roads not paved (or US\$ 350 per square meter). Additionally, it was measured the variables' correlation (see

Table 3) to assess how much the behavior (variance) of an independent variable is influenced by its interaction/correlation with the other independent variables. All values are below 5 meaning that the model is valid and there is no significant correlation among the independent variables.

Table 1: Descriptive Statistics of Main Variables

Variable	n	Average	Std. Dev.	Minimum	Maximum	Skew
(land_area) Land Area (m <sup>2</sup> )	2,452	325.01	152.25	50.00	2,000.00	1.19
(built_area) Built Area (m <sup>2</sup> )	2,452	211.80	99.05	0.00	1,200.00	1.78
(floors) Building Floors	2,452	1.36	0.66	0.00	4.00	1.65
(NJ) Selling Price (Rp/m <sup>2</sup> )	2,452	<b>17,291,632</b>	10,436,696	754,480	85,714,286	0.55
(JRK) Distance CBD (m)	2,452	3,139.94	1,480.15	125.60	7,336.90	0.19
(treat_after) LR Project (0-1)	2,452	0.49	0.50	0.00	1.00	0.03
(g_buffer) Treated Property (0-1)	2,452	0.44	0.50	0.00	1.00	0.23
(LBRJLN) Road Width (m)	2,452	6.46	1.93	0.50	30.00	2.09
(KOND) Road Paved (0-1)	2,452	0.72	0.45	0.00	1.00	-0.98

Table 2: Multivariate Analysis, Dependent Variable Selling Price of Urbanized Land (R<sup>2</sup> adjusted = 0.533)

Predictors	Estimate	Std. Error	Statistic	p	CI
(Intercept)	19,169,967	755,829	25.36	<0.001***	17,687,835 – 20,652,099
(land_area) Land Area (m <sup>2</sup> )	<b>62,316</b>	1,590	39.18	<0.001***	59,198 – 65,435
(built_area) Built Area (m <sup>2</sup> )	<b>-83,234</b>	2,460	-33.83	<0.001***	-88,059 – -78,409
(floors) Building Floors	<b>2,093,301</b>	242,021	8.65	<0.001***	1,618,713 – 2,567,890
(JRK) Distance CBD (m)	<b>-1,448</b>	98	-14.77	<0.001***	-1,640 – -1,255
(LBRJLN) Road Width (m)	92,602	75,582	1.23	0.221	-55,610 – 240,814
(KOND) Road Paved (0-1)	<b>4,722,381</b>	362,057	13.04	<0.001***	4,012,411 – 5,432,352

Table 3: Variance Inflation Factor (Variable Correlation Measure)

(land_area)	(built_area)	(floors)	(JRK)	(LBRJLN)	(KOND)
2.822721	2.860186	1.224765	1.014445	1.028645	1.273360

Interpretation: variance inflation factor exceeding 5 indicates high multicollinearity among the independent variables (although some authors suggest a more conservative level of 2.5 and above which would have indicated that land area and built area are slightly correlated).

### 3.2 Balance of matching

The matching variables used for this particular research were land area (land\_area), built-up area (built\_area), number of floors (floors), distance to the central business district (JRK), a

dummy for treated properties part of a land readjustment project (*g\_buffer*), identification of each one of the eighteen land readjustment projects (*LR\_ID*), the width of the road facing the property (*LBRJLN*), and if that road is paved or not (*KOND*) (see Table 4). The matching was considered successful (see Table 5) as the average distance between the treatment and control units was reduced slightly. 34 samples were excluded to match the control and treated units, totaling 1,209 samples for each control and treatment group.

Table 4: Summary of Balance for All Data

	Means Treated	Means Control	Std. Mean Diff.	Var. Ratio	eCDF Mean	eCDF Max
Distance	0.72	0.26	<b>1.96</b>	0.915	0.3884	0.6693
( <i>land_area</i> ) Land Area (m <sup>2</sup> )	380.30	271.22	0.794	0.8771	0.1847	0.4291
( <i>built_area</i> ) Built Area (m <sup>2</sup> )	209.13	214.38	-0.06	0.4541	0.0634	0.1536
( <i>floors</i> ) Building Floors	1.44	1.27	0.22	1.6992	0.0335	0.0594
( <i>JRK</i> ) Distance CBD (m)	3124.94	3154.51	-0.01	1.276	0.0402	0.0825
( <i>g_buffer</i> ) Treated Property (0-1)	0.41	0.47	-0.11	.	0.0554	0.0554
( <i>LR_ID</i> ) LR Project ID (1-18)	8.08	8.06	0.003	0.9267	0.0152	0.0493
( <i>LBRJLN</i> ) Road Width (m)	6.42	6.48	-0.03	1.0405	0.0443	0.1717
( <i>KOND</i> ) Road Paved (0-1)	0.51	0.91	-0.79	.	0.3969	0.3969

Table 5: Summary of Balance for Matched Data

	Means Treated	Means Control	Std. Mean Diff.	Var. Ratio	eCDF Mean	eCDF Max	Std. Pair Distr.
Distance	0.72	0.26	<b>1.94</b>	0.9044	0.3839	0.6634	1.955
( <i>land_area</i> ) Land Area (m <sup>2</sup> )	380.30	269.20	0.80	0.9652	0.1839	0.4318	0.853
( <i>built_area</i> ) Built Area (m <sup>2</sup> )	209.13	210.49	-0.01	0.5644	0.0596	0.1497	0.5978
( <i>floors</i> ) Building Floors	1.44	1.27	0.22	1.6752	0.0329	0.0587	0.6426
( <i>JRK</i> ) Distance CBD (m)	3124.94	3145.44	-0.01	1.282	0.0397	0.0802	0.9566
( <i>g_buffer</i> ) Treated Property (0-1)	0.41	0.47	-0.13	.	0.0645	0.0645	0.1779
( <i>LR_ID</i> ) LR Project ID (1-18)	8.08	7.98	0.02	0.9412	0.0171	0.0438	0.2848
( <i>LBRJLN</i> ) Road Width (m)	6.42	6.46	-0.02	1.0337	0.0434	0.1646	0.8254
( <i>KOND</i> ) Road Paved (0-1)	0.51	0.91	-0.78	.	0.3945	0.3945	0.7896

### 3.3 Average treatment effect on the treated

Based on the outcomes derived from the matching of sample units and the difference-in-differences estimator, the findings suggest evidence about the land readjustment treatment effect for the whole city of Denpasar. Indeed, the maximum effect of the increase in land prices reaches an average of 5,462,205 Rp. per square meter (or US\$ 400 per square meter,



as of 2017) (see Table 6). Also, the parallel trend assumption held from 1970 to 1980 ( $p < 0.1$ ), as there was no evidence that there was a significant difference-in-differences over time before projects started back in 1982 (see Figure 3).

Table 6: Testing the Coefficient using Cluster Robust Standard Error

Predictors	Estimate	Std. Error	t-value	Pr (> t )	2.5%	97.5%
(Intercept)	15,008,875	174,720	85.90	< 2.2e-16 ***	1,466,625	15,351,493
(g_buffer) Treat. Prop. (0-1)	<b>5,462,205</b>	297,145	18.38	< 2.2e-16 ***	4,879,519	6,044,891

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

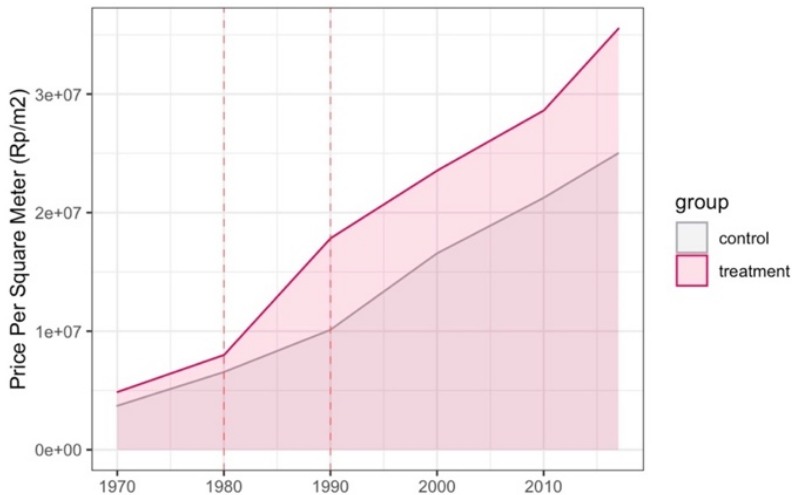


Figure 3: Parallel Trends for Differences-in-Differences Estimator (1970-2017, Matched).

When evaluating projects individually, eight out of eighteen projects were statistically significant and the treatment effect on average ranged from 3,533,735 Rp. per square meter (or US\$ 280 per square meter) to 7,468,376 Rp. per square meter (or US\$ 550 per square meter) (as of 2017) (see Table 7). Projects with positive treatment effects were located around the city center and their average treatment effects were: LRP3 Yangbatu (3,533,735 Rp. per square meter), LRP8 Sumerta Klod Kedaton (7,468,376 Rp. per square meter), LRP10 Panjer (5,538,724 Rp. per square meter), and LRP13 Renon Panjar Sidakarya (4,465,958 Rp. per square meter). Also, projects located in the north and western parts of Denpasar had positive treatment effects and their average treatment effects were: LRP 2 Lumintang (4,884,445 Rp. per square meter), LRP14 Subak Srogsogan (5,388,417 Rp. per square meter), LRP15 Padangsambian Klod (6,252,745 Rp. per square meter), and LRP16 Subak Mergaya (7,390,764 Rp. per square meter). A suggestion for further research would be a more robust analysis to elucidate variations across different project areas and to discern the reasons for disparities in the average treatment effect, despite the similarities in timing.

Table 7: Difference-in-Differences Estimator, Dependent Variable Selling Price (Rp/m<sup>2</sup>)

	LRP1	LRP2	LRP3	LRP4	LRP5	LRP6
g_buffer	6,971,016*	2,695,584***	8,011,055***	2,205,852	339,372	4,996,911***
	(-3,795,051)	(-765,474)	(-824,547)	(-1,372,915)	(-2,707,123)	(-1,371,616)
treat_after	-1,180,641	14,160,287***	15,751,621***	-639,532	-190,714	-326,783
	(-4,222,040)	(-525,894)	(-919,710)	(-1,327,050)	(-2,767,752)	(-1,700,480)
g_buffer: treat_after	191,710	<b>4,884,445***</b>	<b>3,533,735**</b>	3,061,505	-1,823,201	-775,104
	(-4,986,683)	(-979,170)	(-1,420,953)	(-2,026,597)	(-3,835,175)	(-2,066,898)
constant	17,922,465***	4,999,439***	5,428,463***	15,456,542***	21,502,302***	12,995,270***
	(-3,303,596)	(-185,071)	(-178,520)	(-963,542)	(-1,997,373)	(-1,052,526)
	LRP7	LRP8	LRP9	LRP10	LRP11	LRP12
g_buffer	2,150,699	4,350,059***	431,534	12,322,885***	-3,121,114	5,762,529***
	(-1,373,997)	(-878,455)	(-1,663,535)	(-1,236,651)	(-2,822,042)	(-816,621)
treat_after	20,983,898***	12,896,291***	19,363,370***	14,004,468***	-1,531,173	12,029,442***
	(-3,055,642)	(-703,090)	(-1,512,991)	(-841,711)	(-3,246,274)	(-811,627)
g_buffer: treat_after	-92,964	<b>7,468,376***</b>	-3,052,819	<b>5,538,724*</b>	105,749	1,504,782
	(-3,236,090)	(-1,119,008)	(-2,336,571)	(-3,257,770)	(-4,017,569)	(-1,169,564)
constant	5,906,658***	8,470,425***	7,743,880***	7,532,052***	19,973,994***	7,855,790***
	(-1,074,572)	(-449,958)	(-1,512,991)	(-494,902)	(-2,331,567)	(-536,680)
	LRP13	LRP14	LRP15	LRP16	LRP17	LRP18
g_buffer	8,067,670***	2,830,012***	-2,304,588	1,170,465	-284,300	-
	(-1,221,710)	(-1,011,701)	(-1,389,239)	(-1,019,238)	(-1,215,304)	(-)
treat_after	12,103,260***	16,549,676***	17,309,117***	18,966,190***	19,993,852***	12,172,644***
	(-563,840)	(-1,147,630)	(-2,192,189)	(-983,739)	(-4,424,172)	(-1,636,125)
g_buffer: treat_after	<b>4,465,958***</b>	<b>5,388,417***</b>	<b>6,252,745**</b>	<b>7,390,764*</b>	-6,708,667	-
	(-1,417,850)	(-1,909,308)	(-2,350,267)	(-4,288,400)	(-4,640,794)	(-)
constant	7,662,552***	5,799,645***	7,580,226***	6,931,848***	7,058,406***	10,930,266***
	(-361,316)	(-438,199)	(-1,100,874)	(-376,879)	(-769,246)	(-1,207,176)

#### 4. Conclusions

The present research provided a methodology to match multiple real estate-related variables, creating control and treatment groups to evaluate the economic effectiveness of land readjustment projects executed in Denpasar. Importantly, variables such as built area and number of floors are not influenced by land readjustment as construction works were carried out after the project's execution. These variables were important for the sake of matching to make sure we have comparable properties for the difference-in-differences estimator. In Indonesia, different from other nations with improved planning systems, real estate variables are not defined in the planning process, and land readjustment is used just to adapt urban areas to a new property boundaries' structure. Furthermore, there might be uncertainties regarding the increase in property values attributed to the titling formalization process rather than solely to land readjustment. In Denpasar, although legally possible through different mechanisms, formalizing customary land was exclusively achievable through land readjustment during the implementation of all eighteen projects (1982–1997) implying the absence of a confounding variable for formalization without land readjustment. A more simplified statistical analysis with a small number of projects and without proper matching had already indicated possible positive effects (De Souza and Koizumi 2020). In the present research, considering all land readjustment projects, properties located inside land readjustment project areas are likely to be worth US\$ 400 per square meter more when compared to properties in areas urbanized without land readjustment (as of 2017). When evaluating projects individually, eight out of eighteen projects were statistically significant and the treatment effect on average ranged from US\$ 280 to US\$ 550 per square meter (as of 2017). The fact that higher prices have concentrated in areas that have undergone land readjustment suggests that they have been successful in improving the economic conditions of these areas in the long run. However, increased inequality might arise when the government is subsidizing projects (1) without realizing full value-capture through the inclusion of cost recovery land, and (2) without properly collecting proper taxes after the readjustment. The government could have channeled the benefits of the uptrend in land prices through the Land and Building Tax in the long run. This tax is levied at a uniform flat rate of 0.5% based on the capital value of both land and improvements and should have been properly applied following all land readjustment projects.

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