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Exploring the implications of *no net land take* policy for spatial planning: the case of the Netherlands

The European Union's *no net land take* (NNLT) target, which seeks to halt greenfield development by 2050, is very pertinent for planners. The present article investigates its potential impact with special attention for the Netherlands. Given that no single definition or methodology had been established at the EU level, land take was calculated over the 2000–2018 period for alternative definitions. A result is that qualitative approaches oriented to soil quality provide more scope for flexibility than quantitative approaches oriented towards land use. In addition, successful implementation of NNLT will depend on engaging with planners and planning practice.

Keywords: land take, greenfield development, Europeanisation, spatial planning, sustainable development, soil quality, EU policy, Netherlands

Introduction

It is well documented that, despite the fact that the European Union (EU) lacks an official 'competence' for planning in the EU Treaty, its policies – particularly environmental – have far-reaching impacts on planning in the member states (Morphet, 2014; Cotella, 2020; Berisha et al., 2023). This may occur directly when EU legislation mandates that planning systems regulate land use in certain types of areas (e.g. habitats directive, Seveso directive) or more indirectly when spatial plans need to be drawn up to address certain issues (e.g. air and water quality) (Tennekes and Evers, 2024). Planning practices and land use are also affected by subsidy schemes (e.g. agriculture and regional policy) and the conditions attached to these payments (Sielker et al., 2021). EU policy can also affect planning processes (e.g. Strategic Environmental Assessment (SEA) and public procurement) (Tasan-Kok et al., 2013; Colomb and Santinha, 2014; Korthals Altes, 2016). More indirectly, planning is influenced and affected by European information exchange and dialogue. There is no indication that this influence is waning (Sielker, 2018).

Indeed, the EU has wrenched up its environmental ambitions in recent years. The European Green Deal (EGD) provides a framework to guide present and future

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legislation and subsidies (European Commission, 2019). For planners, one highly relevant topic within the EGD is soil quality: the European Soil Strategy for 2030 contains a goal to achieve *no net land take* (NNLT) by 2050 (European Commission, 2021). Land take refers to the conversion of natural and semi-natural land to urban or 'artificial' use, which in planning terms, generally means urbanisation or greenfield development. In this sense, the NNLT ambition cuts to the heart of planning – controlling how cities grow. Although the European Commission has shied away from proposing legislation that mandates the target be achieved in member states, the Soil Monitoring Law proposal published on 5 July 2023 (European Commission, 2023), seeks to implement policy infrastructure that would enable such a policy should it become politically expedient to do so.

Even though NNLT supports the planning ideal of efficient land use, it can clash with the very planning systems and practices that are supposed to implement it. This is because spatial planning, particularly in the 'comprehensive integrated approach' tradition, seeks to strike a balance between competing land-use claims in a democratically legitimate way (Nadin et al., 2021). NNLT, by contrast, is generic (territorially blind) and absolute (Decoville, 2018). The potential for conflict is potentially high in the Netherlands, which exemplifies this approach. According to the most common operationalisation maintained by the European Environment Agency, this country had the highest land-take intensity in the EU27 in the 2000–2018 period (Evers and Van Schie, 2019). Moreover, current national planning policy is oriented towards accommodating various social, economic and environmental challenges (e.g. constructing one million new homes before 2030), which will inevitably involve more land take. Depending on the operationalisation of NNLT, this can result in a minor or major challenge for Dutch planning.

The present article presents the results of research conducted in 2022 intended to estimate the potential impact of NNLT for the Netherlands (Evers et al., 2023). Because the European Commission had yet to publish its legislative proposal, the study explored *ex ante* the implications of hypothetical policy approaches and land-take definitions. Even though the focus was on the Netherlands, the results should be relevant for most member states. Since the proposal of 5 July 2023 fails to clarify the most important issues signalled in the study, the findings remain valid. The following section grounds this research in the scholarly debate on how European sectoral policies affect planning and how *ex ante* Territorial Impact Assessments (TIAs) can support successful implementation. This leads to a short description of the EU policy process surrounding NNLT. The next section explains the methods and data used for the *ex ante* assessment. The findings are discussed in two parts. The first shows how different interpretations of land take produce widely different results, underlining the importance of definitions and operationalisation. The second part deals with methodological/technical issues that manifested themselves during the study. The conclusions reflect on the implications for spatial planning in the Netherlands and beyond.

Tensions between sectoral and spatial policy

Planning as a balancing act

When considering interdisciplinary versus specialist knowledge, there is an inherent trade-off between breadth and depth. The ideal position along this continuum – if one should exist –depends on the topic at hand. Like disciplines, some policy areas are by nature more narrowly defined than others. As many different interests and perspectives converge in land-use decisions, spatial planning tends to be broad and cross-cutting with no overall objective (Hossu et al., 2022), as opposed to, for example, health, regional economic development, transport or water quality. Indeed, spatial planning, particularly the 'comprehensive integrated approach' variant (European Commission, 1997), is conceptualised as the act of balancing competing interests in a democratically legitimate way to arrive at sound land-use decisions (Solly, 2021). In a personal reflection, Patsy Healey (2017, 107) defined planning as follows:

> After many decades of engagement with the planning field, I have come to understand planning as a sociopolitical project centred on collective endeavours to shape place qualities to promote better trajectories than might otherwise occur. For me, places are locales, landscapes, territories which we inhabit, imagine and seek to shape. Planning, understood in this way, is a form of 'place governance', sociopolitical practices concerned with the development and management of places.

In this 'development and management of places', spatial planning practice usually employs general principles, participatory processes and indicative cartographic visualisations of future development pathways to inform a particular planning decision, which is only later codified into a legally binding document (e.g. zoning plan, planning permission). As these processes and dialogues are repeated over time, a common understanding can emerge. Eventually this can coalesce into a 'planning doctrine' consisting of, 'a body of thought concerning (a) spatial arrangements within an area; (b) the development of that area; (c) the way both are to be handled' (Faludi and van der Valk, 1994, 18). Spatial planning therefore encompasses both process and substance, both means and ends, and both grand visions and mundane land-use permitting processes.

The Netherlands is often upheld as a textbook example of this broad conceptualisation of comprehensive integrated planning (Nadin et al., 2021; Solly, 2021). It produces national strategies which are made increasingly concrete and binding at the provincial and municipal levels in a process of intergovernmental and multi-level collaboration (Needham, 2014). The reputation of Dutch planning moreover rests on its long-standing national policies to steer urbanisation (Van der Wouden, 2021). Although most of these were abolished over the past two decades in successive reforms to simplify, decentralise and deregulate planning (for a full explanation see

Zonneveld and Evers, 2014), one has remained: the sustainable urbanisation procedure or 'ladder' which obliges zoning plans allowing new urban development to provide justification about the need, and, if on a greenfield site, argue why an infill location was not selected. The ladder works indirectly: it does not forbid or restrict greenfield development per se, but instead obliges municipalities to be explicit about why they are allowing it (Salet, 2014). Similarly, the national strategy on spatial planning and the environment offers three principles when balancing competing interests and priorities: 1) try to combine land uses, 2) try to protect the identity of places and 3) avoid passing burdens on to others [own translation] (Ministerie BzK, 2019).

Spatial planning can come into conflict with more well-defined (sectoral) policy fields. In many cases the underlying goals are complementary as all these policies attempt to improve the human condition. However, the translation of sectoral policy goals into operational measures and processes can – and frequently do – clash with planning practices. On the one hand, this occurs because a narrow focus and inflexible norms can undermine the search for optimal solutions (Salet and de Vries, 2019). On the other hand, such policies are often territorially blind (e.g. by imposing generic 'one size fits all' standards), resulting in potentially inappropriate situations in some areas (Camagni, 2009; Doucet et al., 2014). This tension becomes intensified when binding sectoral policies are set at the European level, because they cannot be easily adapted if they conflict with everyday planning practice or with each other (Sandström and Elander, 2019). Consequently, planning's aim to influence future spatial development in a flexible way that is tailored to the local context (Healey, 1996) may be impossible if, for instance, strict performance targets provide little or no room to manoeuvre (Salet and de Vries, 2019). The preoccupation with compliance in the field of environmental policy, one of the most relevant policy areas for planning, is particularly poignant in this regard (Jordan, 1999). In the Netherlands, the impact of EU environmental policies (e.g. air quality, nitrates) on planning has been highly controversial, particularly when it blocks new urban development (Tennekes and Evers, 2024).

Evaluating territorial impacts of EU policies

The disadvantages of inadequate EU sectoral policy coordination has been known for decades (Robert et al., 2001), such as clashes between nature (Natura 2000) and transport infrastructure (TEN-T) (Byron and Arnold, 2008) or between regional and competition policy (Colomb and Santinha, 2014). Although attention has repeatedly been drawn to the need for 'a place-based approach' (Barca, 2009), this has yet to become common practice in European policymaking. Given the lack of a competence for planning in the EU Treaty, there is no European institution with the powers to, for example, create a spatial strategy that brings coherence to the multitude of policies affecting planning (notwithstanding the toothless intergovernmental European Spatial

Development Perspective and Territorial Agenda). Nor is there a body to coordinate European spending in a way that consistently promotes territorial cohesion across policy fields (Crescenzi et al., 2011). Of course, there are various mechanisms for coordination and checks within the legislative process, including the mandatory *ex ante* Impact Assessment (IA) carried out by policy initiators at the EU level (European Commission, 2009), but ultimately most policy conflicts are managed within member states to varying levels of success (Tennekes and Evers, 2024).

Over the years, there have been various calls to improve coordination at the EU level by subjecting legislative proposals to TIAs in addition to or as a replacement for the IA. In the early years of TIA development, this generally took the form of bespoke *ex ante* evaluations requiring cumbersome research designs and data collection to assess all European regions simultaneously. ESPON took the lead in this regard, producing reports on the impacts of the CAP, TEN-T policy, R&D and regional policy (Faludi, 2008; Evers, 2011). Over the past decade, attention at ESPON shifted to developing a TIA methodology that could be applied to any given policy proposal at any stage in the policymaking process. An important outcome was the 'quick scan' tool which combined the conceptual work of the ESPON TIA project on environmental policy (Greiving et al., 2008) and an ESPON model drawn up for a multicriteria analysis of transport and agriculture (Camagni, 2009). The quick scan tool produces maps of territorial impacts based on user input, usually derived through an expert workshop and is freely available online (Dallhammer et al., 2020). In parallel, the European Commission published a guide to assist in deciding whether a TIA is necessary and how to carry it out (European Commission, 2013) as well as an overview of TIA methodologies, models and tools. These ideas have since found their way into the IA guidelines. At present, there is sustained political support for conducting TIA-like assessments on EU policy proposals on a voluntary basis, and a TIA manual will be published as part of the TA2030 actions to support this.

Land take within European environmental policy

TIA methodologies have immediate relevance considering the increased ambitions in environmental policy, which has arguably the most significant spatial/territorial effects. The Paris Agreement marks an important turning point in pushing climate change to the mainstream of European policy, and the EGD (European Commission, 2019) has become a key framework for drafting new legislation and disbursing funds. With respect to the latter, a 'taxonomy' has been drawn up that explicitly describes which activities can be deemed sustainable and thus eligible for EU support. Central concepts of this broad strategy include resource efficiency, conservation of natural capital and reducing hazardous pollution and environmental risks. More concretely, the EGD has led to the adoption of the EU Biodiversity Strategy for 2030, a Zero

Pollution Action Plan, an EU Climate Adaptation Strategy, the Nature Restoration Act and an EU Soil Strategy for 2030 (European Commission, 2021), which seeks to put soil protection on an equal footing with air and water quality.

The soil strategy reiterated the aim to achieve NNLT by 2050 which had been first articulated in the *Roadmap to a Resource Efficient Europe* as a way to protect fertile soils delivering ecosystem services (European Commission, 2011). NNLT essentially calls for a moratorium on the conversion of rural/natural land to urban use. Since then, various European documents and reports have been published in support of this goal – for example a Future Brief on best practices (European Commission et al., 2016) – but no binding policy has been adopted. The EU Soil Strategy for 2030 (European Commission, 2021) signalled a change, announcing that the European Commission would make a legislative proposal for a Soil Health Law that would presumably include NNLT. In the intervening years there has been much speculation about how binding the policy would be, at what level of scale NNLT should be achieved, which land uses constitute land take and how this should be measured (Decoville, 2018; Decoville and Feltgen, 2023). In anticipation, Italy for example introduced legislation establishing a monitoring and reporting system and France is well advanced in both monitoring and implementation (Colsaet, 2019). Germany, Flanders, Austria and Luxembourg have land-take reduction policies in place (Fina et al., 2023; Lacoere and Leinfelder, 2023). Other member states, including the Netherlands, have adopted a more circumspect approach.

On 5 June 2023, the long-awaited legislative proposal was published. Tellingly, the proposed directive's title had changed to the Soil Monitoring Law, which could be read as either a reduced ambition or a strategic first step. Article 3 sets definitions, including those vital to NNLT (European Commission, 2023, 32). The relevant sections of this article are listed below:

- (17) 'land take' means the conversion of natural and semi-natural land into artificial land;
- (14) 'natural land' means an area where human activity has not substantially modified an area's primary ecological functions and species composition;
- (15) 'semi-natural land' means an area where ecological assemblages have been substantially modified in their composition, balance or function by human activities, but maintain potentially high value in terms of biodiversity and the ecosystem services it provides;
- (16) 'artificial land' means land used as a platform for constructions and infrastructure or as a direct source of raw material or as archive for historic patrimony at the expense of the capacity of soils to provide other ecosystem services.

There is considerable ambiguity in these definitions. For example, with respect to semi-natural land, the criterion 'potentially high value' is unclear as is the rather

cryptic wording 'archive for historic patrimony' with respect to artificial land. Linking these definitions to, for example, land cover classes or levels of soil degradation for purposes of monitoring would be challenging. Article 11 (Land take mitigation principles) is not much help either. For indicators, the proposal refers to Annex 1 part D, which, according to art. 8(5) should be updated annually. However, these indicators are mainly derivatives of land take (e.g. land take per km² and per year) rather than an operationalisation of the term itself. Similarly, art. 9(3) states that the impact of land take on ecosystem services must be assessed. From this, it may appear that that European Commission has decided to defer the operationalisation of land take to a later stage of policymaking. However, this is essential for monitoring.

Furthermore, Article 11 does not obligate member states to achieve NNLT by 2050. Instead, they should 'avoid or reduce as much as technically and economically possible the loss of the capacity of the soil to provide multiple ecosystem services, including food production' (European Commission, 2023, 38). The absence of a binding quantitative performance target must come as a disappointment to some and as a relief to others. However, if ratified, the Soil Monitoring Law does provide the cornerstone for implementing a binding policy, so it cannot be ruled out that this will not be introduced later.

Research design and methods

Given that NNLT is still at an early phase in European decision-making, there is significant ambiguity surrounding definitions and member state obligations. At the time of the study (carried out in late 2022), only the NNLT target was known and that a legislative proposal was in the works. Given the context, the study opted for a pragmatic broad-brush TIA approach consisting of various quick-scan analyses that would provide insight into orders of magnitude. Uncertainties, for example about definitions, were explored by means of what-if scenarios and alternatives. This approach follows TIA guidelines drawn up by Tennekes and Hornis (2008) to evaluate European Commission legislative proposals which are summarised in English in Evers et al. (2009), which applied them to explore the implications of competing definitions of territorial cohesion for the Netherlands. This latter study comprises the methodological point of departure for the present research.

A major uncertainty in the policy debate concerns the definition and operationalisation of the term land take or artificialisation. To estimate the impact of different plausible definitions, the analysis performed the following steps:

- surveying existing interpretations and definitions of artificialisation/land take;
- operationalising the different interpretations using quantitative data;
- calculating land take in the 2000–2018 period for each interpretation.

To improve comparability, European or global data was used as much as possible in the analysis. It was anticipated that future NNLT policy would favour this approach for monitoring compliance across member states. The main data source was Corine Land Cover (CLC) and Corine Land Cover Change (CHA) for the 2000–2018 period and Eurostat data. Unless otherwise stated, all calculations regard current EU member states (EU27) and are expressed in hectares. To simplify analysis and presentation, the 11-category grouping of Corine use classes from the ESPON SUPER project was used (Van Schie et al., 2020), unless nuance required addressing land use at the Corine 44-category level.

Most calculations were carried out for all EU27 member states, allowing rankings to be performed in the amount of land take and providing insight into which countries would be affected most by different interpretations. Given the Netherlands' reputation as exemplifying the spatial planning approach described above, this served as a benchmark case throughout. Because the qualitative analysis necessitated unconventional methods and local data, this could only be performed for a single country, further justifying a case study approach.

Substantive findings: impact of alternative definitions

There is a general agreement, including the definition given in the Soil Monitoring Law proposal, that 'land take' concerns the conversion of (natural or agricultural) land use to (semi-)urban functions, especially soil sealing. In Euro-English this process is sometimes referred to as the 'artificialisation' of land (European Commission, 2023). It stands to reason that if NNLT becomes a substantive obligation under European law, an unambiguous definition must be established. And, if this obligation entails monitoring and reporting, then land take or artificialisation must be operationalised using quantifiable and preferably standardised indicators. Over the years, various definitions of land take and related concepts have been given in European research and policy documents, within countries and in international expert panels and forums (Marquard et al., 2020). From these definitions, two interpretations have emerged concerning the related terms 'land' and 'soil'.

Most definitions regard 'land' and look purely at *quantitative* land-use change to urban or 'artificial' functions. Land take can therefore be unambiguously expressed in hectares, which also applies to the opposite process (e.g. de-urbanisation). Differences between definitions mainly regard what functions should be considered natural or urban. Consensus exists on built-up areas such as residential and commercial zones, and many definitions also explicitly mention infrastructure, but grey areas remain (e.g. construction areas, landfills, horticulture, mining areas, wind turbines and solar farms). In addition, parks, public and private gardens, golf courses or recreation areas are usually considered urban, but are largely unpaved and can deliver ecosystem

services. Some differences regard the original function (i.e. what was 'taken'): nature, forests and agriculture are usually mentioned, but also 'semi-natural' land such as mowed pastures as well.

The second type of definition regards 'soil' and emphasises *quality* and possible future uses. French environmental law, for example, defines land take as the degradation of ecological functions of the soil (Colsaet, 2019). Because this implies a more qualitative approach (degradation suggests a sliding scale), gradations of land take may be possible, so that, when calculating land take, a hectare of land providing crucial ecosystem services should count more than a hectare with average quality. A related discussion regards the disappearance of fertile agricultural land, which requires knowledge about the type of agriculture (e.g. horticulture, arable, pasture) being converted.

Quantitative results: land-take volumes according to different definitions

This analysis consisted of a calculation of hectares of land take in the 2000–2018 period using Corine change data according to different definitions. Disregarding the European Environment Agency's land consumption definition (which includes conversion to intensive forestry and agriculture), gross land take according to the broadest working definition can be considered a maximum value. The results are displayed in Figure 1. In absolute terms, the Netherlands occupies the sixth position after Spain, France, Germany, Poland and Italy. However, when land take is divided by total land mass (an indicator of intensity), the Netherlands heads the list. In terms of relative growth (land take relative to the urban footprint in 2000), the Netherlands again ranks sixth. This analysis suggests that the Netherlands will be one of the member states most affected by land-take policy because it will entail a considerable change in development practices.

All the above figures concern gross land take. To calculate net land take, we subtracted the number of hectares of urban/artificial land reverting to non-urban functions. In the Netherlands, this 'reverse land take' was 5,833 hectares in the 2000–2018 period, yielding a total net land take of 63,857 hectares. Further investigation revealed that reverse land take mainly concerned abandoned building sites and, to a lesser extent, conversions of quarries and landfills to nature; only 5 hectares of urban fabric and 25 hectares of industrial land were deurbanised. Dutch gross land take is almost 14 times greater than reverse land take; urbanisation can thereby be considered a one-way process. The Netherlands is not exceptional in this regard, but there is great variation between member states. The Czech Republic, Germany and Luxembourg have only four times as much gross land take, so the 'net' aspect of the policy is important for meeting their NNLT target. Incidentally, the Netherlands' ranking in terms of intensity and growth is the same for both gross and net calculations.

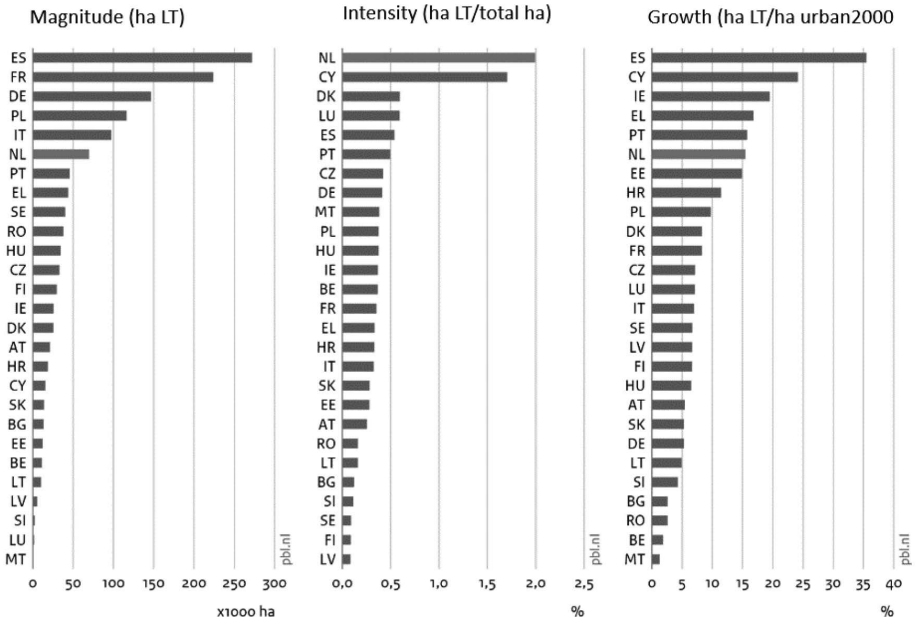

Figure 1 Land take in the EU27 (2000–2018)
Source: Author (CHA data)

Achieving NNLT will also depend on which land-use categories are included in the definition. To estimate the impacts of different land-take definitions, CLC land-use classifications were subtracted from the broadest definition used above in the order of their likely omission. This was done by a general reading of definitions and the kinds of uses mentioned as (semi)natural and artificial. Although the legislative proposal does not explicitly mention land use classes in its definitions, the general introduction (point 30) contains the phrase 'natural and semi-natural areas (including agricultural and forestry land, gardens and parks)', implying that urban green and unbuilt parts of urban fabric are not artificial (European Commission, 2023, 24).

To calculate the new land-take increase after deleting a category, two steps are required. This is because repeatedly subtracting categories from the broad definition reduces not only gross land take but also potential reverse land take. As an example, we can consider how the exclusion of the CLC classification 'urban green' changes the amount of land take in the Netherlands. First, the number of hectares of urban green is subtracted from the land-take total because it is now considered non-urban (69,690 – 7,875 = 61,815). However, since urban green is now a non-urban category, all land use change from it to the remaining urban uses such as housing, industry and

infrastructure (1,123 ha) is now considered land take and must be added back (61,815 + 1,123 = 62,938). The next step is to calculate reverse land take. Given that urban green is now considered as non-urban, its conversion to, for example, agriculture or nature no longer counts as reverse land take (5,833 – 13 = 5,820). Therefore, the net land take for the first alternative definition (without urban green space) is 57,118 hectares (62,938 – 5,820). The analysis was performed for all EU27 member states, but for the sake of readability only the Dutch data is presented below.

Table 1 Absolute land take (in ha) in the Netherlands according to various definitions (2000–2018)

Definitions	Gross (ha)	Net (ha)
Broad definition	69,690	63,857
- urban green	62,938	57,118
- urban green, artificial	60,625	55,429
- urban green, artificial, construction sites	47,597	47,488
- urban green, artificial, construction sites, infrastructure	45,008	44,978

Source: Author (CHA data)

As the results in Table 1 show, even if the narrowest definition is applied (which is highly implausible) this reduces Dutch land take by only about a third. This is certainly helpful in bringing the Netherlands closer to the target of zero, but the same is true for the other member states. Because of this, the alternative definitions have little effect on the Dutch position within the EU (Figure 1).

As an auxiliary analysis, land take was also calculated with respect to population development as this is common practice for measuring sustainable urban development (e.g. Sustainable Development Goal 11.3). The unitless indicator Land Use Efficiency (LUE) was first considered. This divides the percentage of urban growth by the percentage of population growth, with results below 1 being deemed sustainable (Li et al., 2022). A criticism of LUE is that it does not take path-dependency into account, i.e. a dense region that grows 1 per cent in area and population would receive the same score as a sprawling region growing by 1 per cent in size and population. An alternative proposed by Schiavina et al. (2019) is Marginal Land Consumption per New Inhabitant (MLCNI) which, as its name suggests, divides the change in urban area by the change in population. Table 2 presents the results of these indicators for the Netherlands. Because household development is considered a driver of urbanisation as well as population, this was also calculated.

Table 2 Relative land take in the Netherlands according to various definitions (2000–2018)

Definitions ***	LUEpc*	LUEhh*	MLCNIpc**	MLCNIhh**
Broad definition	1.71	0.91	0.0485	0.0601
- urban green	1.50	0.80	0.0425	0.0527
- urban green, artificial	1.46	0.77	0.0413	0.0513
- urban green, artificial, construction sites	0.56	0.30	0.0159	0.0197
- urban green, artificial, construction sites, infrastructure	0.49	0.26	0.0139	0.0172

* LUE has no unit as it is a ratio of two rates of growth
**measured in hectares
*** pc = per capita, hh = per household
Source: Author (CHA and Eurostat data)

The results reveal a wide divergence. According to the broad definition, LUE per capita is clearly unsustainable, with urban development growing almost twice as fast as population. LUE per household is however sustainable because Dutch household size is shrinking. This difference is maintained for all working definitions, the last of which appears quite sustainable. The picture changes somewhat for MLCNI. According to the broadest definition 485 m^2 of urban space (0.0485 ha) was created for each new inhabitant and 601 m^2 (0.0601 ha) per household in the 2000–2018 period. Incidentally, most of this urban growth concerns non-residential uses like business parks and logistics centres. The broad political support for addressing housing shortages is therefore not inconsistent with this analysis. Like LUE, MLCNI drops considerably in the narrowest definition of land take to 139 m^2 and 172 m^2 for population and households respectively.

In comparison to the absolute land-take values, the Netherlands occupies a more favourable position within the EU on these relative measures. LUE is particularly problematic in Portugal where the urban area expanded by 15 per cent but the population remained relatively stable. Similarly, the population of Greece, whose land take was comparable to the Netherlands, fell in the 2000–2018 period. Also the Slovak Republic, Germany and Spain were less sustainable. Belgium, Luxembourg, Sweden and Austria performed better than the Netherlands. Similar results were obtained for MLCNI: the least sustainable countries were arguably those whose land take was accompanied by a shrinking population. Portugal in this case added a hectare of urban land for every new inhabitant.

Qualitative results: ecosystem services of land use categories

The qualitative approach is still far too unarticulated to warrant an analysis of alternative definitions. Because of this, the analysis sought to explore how soil quality could be incorporated into NNLT monitoring. Given the fact that soil qualities vary widely

between member states, and the lack of pan-European data coverage, the analysis limited itself to the Netherlands.

The most straightforward way to estimate how much soil quality was lost in the 2000–2018 period would be to cartographically overlay land-take locations onto soil quality maps for 2000. Unfortunately, the latter information was unavailable. What was available were 16 maps of soil-related ecosystem services for the present situation, meaning that it should be technically possible to monitor soil quality loss due to land take in the future. For the 2000–2018 period, an alternative approach was carried out, which calculated soil quality of CLC classes.

The first step of the analysis was to assess the 44 land use classes in the Corine database according to their current ecological values by using the current cartographic material. To this end, the legends of the 16 maps were normalised and stacked, producing a composite map of all 16 soil-related ecosystem services. This allowed an average value for each CLC land use class to be calculated for the Netherlands.

The alternative analysis discovered that, of all CLC classifications, vegetated nature scores by far the best. Remarkably, this is followed by urban green, scoring higher than water and non-vegetated nature on soil-relevant ecosystem services. Agriculture, by contrast, scores about the same as urban fabric, landfills and construction sites, although CLC class 243 (agriculture with natural planting) is higher. The lowest soil quality was found for industry, reclamation sites and infrastructure. It must be stressed that these results cannot be generalised outside of the Netherlands because both Dutch agriculture and nature are characterised by a comparably large human footprint.

Table 3 Quality of CLC classes resulting from ecosystems analysis

Aggregated CLC class	Average sum*	Score**
Urban fabric	245.4	5.6
Industrial (including commercial/office)	220.2	5.1
Infrastructure (including airports)	236.1	5.4
Mineral extraction sites	221.9	5.1
Dump sites	241.3	5.6
Construction areas	240.5	5.5
Urban green and recreation	310.4	7.1
Agriculture	244.8	5.6
Nature – vegetated	434.4	10.0
Nature – not vegetated	296.8	6.8
Water – wetlands and water bodies	248.7	5.7

* Average sum is the total score on the normalised 16 ecosystem maps (0–1600 scale)

** Score is determined as a share of the best scoring category (x10)

Source: Author (CLC and Alterra data)

Even though this analysis should emphatically be regarded as a very rough initial indication, the results are striking and highly relevant for the policy debate. If, for example, only soil quality at levels 6 or higher would be considered as land take, total land take in the Netherlands would be negative in the 2000–2018 period due to large-scale conversions from agriculture to nature. While this is unlikely, the above analysis provides justification for the removal of urban green from the definition of land take as well as making a distinction between agriculture and nature when determining land take. For example, taking land from nature could be weighed more heavily than that taken from agriculture. This measure would reduce land take in most member states (particularly the Netherlands, Ireland and Denmark) and penalise those where nature is the source like Finland, Sweden, Croatia and Portugal.

Methodological findings: practical hurdles to implementation

The European Commission's proposal focuses on monitoring soil quality, including land take. Some member states (e.g. France and Italy) have established a monitoring system in anticipation of this requirement, whereas others (e.g. Belgium, Germany, Luxembourg) monitor progress towards domestic targets. In the course of the study, it was found that land-take monitoring in the Netherlands should be relatively unproblematic, as similar indicators are regularly calculated using national land cover data. However, potential bottlenecks were also signalled.

For example, operational choices can undermine monitoring feasibility. Opting for high-resolution geodata or sophisticated land-take calculations can outstrip expertise and computational capacity. During the study, we discovered that refined Sentinal data (global land use) proved cumbersome as did the qualitative analysis with ecosystem services. Another problem regards composite indicators, especially when derived from multiple sources. It should be remembered that the lowest common denominator determines the overall quality, usually resulting in a loss of information vis-à-vis single-source indicators and complicating time–series calculations (e.g. if one sub-indicator is updated every three years and another every five years). Given the frequency at which most land cover datasets are updated (six years for Corine), the requirement for annual updates cited in the Soil Monitoring Law proposal is highly unrealistic.

Data and operationalisation issues

In theory, once a definition is established, tallying the number of hectares of urbanised land should be straightforward. In reality, considerable technical hurdles must be overcome, especially with respect to European data. The use of relatively

low-resolution CLC data to measure land take has been heavily criticised (25 ha for state data and 5 ha for change data). The ESPON SUPER project investigated the accuracy of the dataset by comparing the CLC2012 map with the higher-resolution Global Urban Footprint dataset from the same year (Van Schie et al., 2020). This comparison revealed two types of errors: 1) areas designated as urban in CLC with few or no buildings; and 2) built-up areas not registered as urban in CLC. In the first case, new construction will not be registered as land take (because already urban) and in the second case, it will be either discounted entirely as land take or possibly overestimated if the new development results in a reclassification as urban. Further analysis showed little regularity in the two error types across the European territory, making this problem difficult to identify and correct. As a result, spurious conclusions can be drawn with significant policy implications. In Flanders, for example, many provincial roads with occasional houses were designated as urban areas in the 2000 version of the Corine database. Consequently, further sprawl along these roads in the 2000–2018 period is not considered land take. This finding is at odds with national analyses and Flemish policy which seeks to concentrate development in urban areas (Lacoere and Leinfelder, 2023). Because urbanisation in the Netherlands usually transpires through relatively large projects, this problem is less acute for the Netherlands, and the land-take figures according to national (Statistics Netherlands, CBS) data do not differ significantly from CLC.

CLC classifications are also problematic for land-take monitoring. For example, a wind turbine or solar farm (coded as industry) takes up relatively little space on the ground but needs surrounding infrastructure that may require paving. As a result, Corine draws liberal contours around these turbines, which partly explains the high transformation from nature to industry in the UK (Cole et al., 2022). Sometimes nearby trees are cut down or vegetation removed, which can affect soil quality, but this may not be coded as a land cover change. Horticulture poses another conundrum: this is classified in Corine as agriculture (non-irrigated arable land). Consequently, replacing greenhouses with a recreational area or low-density housing could be labelled land take. This would be farcical because, according to national land use key figures, soil sealing of horticulture in the Netherlands is about 90 per cent, whereas a low-density suburb is about 25 per cent and only 5 per cent for recreational areas.

Even though the legislative proposal contains a definition of land take, this is far too vague to serve as a guide for monitoring. Any future operationalisation will have to address problems with respect to temporary and/or multifunctional land uses such as renewable energy production (wind farms and solar arrays), gardens (private green space) and agriculture (livestock sheds and horticulture). A fundamental choice will also need to be taken for either a land use approach based on function (Corine) or a soil-sealing approach based on buildings regardless of their function (e.g.databases such as Global Urban Footprint, World Settlement Footprint, or Global Human

Settlement Layer). Moreover, the relationship between soil quality and ecosystem services needs to be thoroughly thought through. Reverse land take, for example, may not restore the land to its original soil quality, especially if it has been contaminated, which can affect how much this measure should contribute to calculating net land take. Specifically for the Netherlands is the issue of land reclamation: should this be considered reverse land take?

Implementation issues

The unresolved policy issues surrounding the implementation of NNLT are even more formidable than the technical ones already raised. Moreover, these will directly impact spatial planning. Most fundamentally, if NNLT is a pan-European target rather than a member state obligation, could reverse land take in some areas (i.e. shrinking regions in Bulgaria) compensate for land take in areas with high urbanisation pressure? If so, this could pave the way to land-take certificates akin to the Emission Trading System, something which has been explored in Germany (Grimski, 2019). If, instead, NNLT must be achieved within each member state, this will create governance conundrums depending on the prevailing administrative structure: how can compliance or cooperation be achieved in federal versus unitary systems, will local or regional performance targets be allocated (and according to which logic) and what kinds of policy strategies (regulatory versus incentives) will be followed? It is conceivable that resolving all these issues at a European scale could take years, if not decades, of negotiations.

There are also unanswered questions about how NNLT should interface with existing planning processes. Land and soil have been a mandatory part of Environmental IAs since 2014 (Vargas, 2019), but wouldn't this be too late to be effective? By that time, most urbanisation initiatives have acquired too much momentum to be stopped by a non-binding policy. Alternatively, NNLT could be applied at the strategic level (SEA), which establishes general principles and sketches out desirable spatial structures. However, in this case NNLT runs the risk of being brushed aside when operational land use decisions are taken, and more pressing political issues take priority. To avoid this, NNLT should become an integral part of the overarching planning ideology or doctrine, something which is by no means certain – planners often pride themselves on their ability to accommodate rather than block initiatives.

Discussion and conclusion

The *ex ante* impact study described above had a rather narrow focus. It explored how differing interpretations and methodological approaches affect how much land take is deemed to have taken place in the Netherlands in the 2000–2018 period. This provides

a rudimentary indication of how challenging it will be to reduce it to zero by 2050. It also revealed some major issues that can hamper implementation. These pertain to problematic and vague definitions and unclear methodologies, operationalisation and data sources. Given that the Soil Monitoring Law proposal has not addressed these issues sufficiently, the results remain valid. More interesting for planners, however, is implementation: how will NNLT be administered? Here too, the legislative proposal is unhelpful. A few principles are provided (e.g. try to avoid or reduce land take), without cues about how these should be applied. As the policymaking process progresses, it will become increasingly necessary to confront what the implementation of a NNLT regime, namely, halting greenfield development, would entail.

As spatial planning is generally responsible for controlling urban development, the success of NNLT hinges on how it engages planning. Environmental policy would like to believe that planning will faithfully and obediently carry out the task assigned to it using all the powers at its disposal. In reality, NNLT will be just one of many competing interests within the everyday balancing act of producing land use decisions. It is by no means certain that it will be the most important factor, especially if it does not align with prevailing planning doctrines and practices. We therefore agree that 'the fight against land take cannot be isolated from other crucial issues to which our societies are exposed, such as the need for new housing, jobs, and public facilities' (Decoville and Feltgen, 2023, 7).

Fortunately, NNLT is largely consistent with most planning thought on urbanisation, which supports a compact or polycentric urban form above more organic or 'sprawl' development. Many member states have policies in place to this end, such as the Dutch 'ladder' for sustainable urbanisation. However, as pointed out by Cowell and Martin (2003), problems usually concern means rather than ends. In this sense, there is much potential for conflict. NNLT is posited as an absolute norm (zero), whereas spatial planning tends to favour a more flexible approach to allow for balancing interests. Similarly, NNLT poses a strict deadline (2050) whereas most long-term spatial strategies consider multiple futures and alternatives to enhance robustness. Finally, NNLT is aspatial: in theory, each territory will need to comply with this norm, despite enormous differences with respect to development pressures. It is not surprising that the first reaction of planners towards NNLT is often a combination of suspicion and disbelief.[1] Instead of being embraced as an ally in the fight against sprawl, NNLT is viewed as an impediment (in the Netherlands, it is often mentioned alongside the nitrates directive which is currently blocking development projects). It is therefore advisable that policymakers supporting NNLT take

1 This was apparent at a well-attended seminar on 27 January 2023 organised by the author which brought together planners in various capacities (government, developers, consultants) throughout the Netherlands. The video of the seminar, presentations and the seminar report can be obtained at: https://www.pbl.nl/actueel/nieuws/terugblik-pbl-seminar-stopt-europa-de-verstedelijking.

steps so as not to alienate those who will be ultimately responsible for its implementation. Bearing this in mind, we can reflect on the two main approaches to NNLT posited in the *ex ante* study.

The quantitative approach has the advantage of working with concepts familiar to planners (i.e. geographically delineated land use classes). In addition, progress towards NNLT (i.e. hectares of land take) can be monitored via the planning system (the Netherlands even has information about plans in the pipeline). The planning system can also be used for evaluating initiatives with respect to land take, but only if it is clear which land use classes constitute land take, or its reverse. The implementation of the Dutch 'ladder' for sustainable urbanisation was hindered by legal/technical discussions about what constituted a 'new urban development', and years of litigation were necessary to provide the desired clarity (Evers et al., 2020). When imposing regulations that could affect land-use decisions, definitions are anything but trivial, and those provided in the Soil Monitoring Law proposal are far from adequate for implementation.

The qualitative approach has much less affinity with land-use planning. Ecosystem services are not necessarily place-based and soil quality is not generally an issue in zoning plans. If this interpretation dominates NNLT policy, one could imagine an implementation regime running in parallel to spatial planning, for example, a requirement to produce a report demonstrating minimal impact on soil quality, analogous to other environmental checks. The bookkeeping would then not be linked to spatial planning but occur elsewhere. The crux would concern the extent to which planning permission would be made dependent on soil quality. Should a hard norm be set with respect to degradation? Should the report be advisory or binding? On the other hand, by virtue of its vagueness, the qualitative approach seems to provide more scope for flexibility than the quantitative approach. Spatial and sectoral policies improving soil quality in cities (e.g. parks, private gardens, etc.) could then be used to offset approved greenfield development, especially if the latter takes place on low-quality farmland. This kind of balancing act should be immediately recognisable to planners.

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