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SPATIAL PLANNING NEEDS TOWARDS COPERNICUS LAND MONITORING SERVICES: CASE STUDIES FROM POLAND AND NORWAY

Abstract. The objective of this study is to identify the needs related to geospatial LC, LU, and LCLUC information for spatial planning in Poland and Norway, and examine the usefulness of CLMS products in the context of these planning systems. The research has conducted based on a comparative analysis of two planning systems, to indicate areas where CLMS can improve or supplement national spatial data. The study shows that CLMS can provide information on up-to-date spatial data showing actual LC/LU/LCLUC, but that the degree of detail and the accuracy may be insufficient. CLMS data is harmonised across Europe and thus meets the need expressed by international organisations, for data that are consistent at a continental level. This is not a requirement in national planning systems in Poland and Norway, where the needs are regulated by national legislation. The thematic and geometric accuracy of national data sources are usually better than the data provided by CLMS, but CLMS might fill gaps when specific topics are missing in national mapping programs.
Key words: CLMS, spatial planning, Poland, Norway.

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1. INTRODUCTION

Copernicus is the European Union's Earth Observation Programme, which provides information aiming to improve the management of the environment, understanding, mitigation, and adaptation to climate change and addressing security issues (Aschbacher, 2016; Jutz and Milagro-Pérez, 2020). The programme consists of a space segment and a ground segment. Copernicus provides services focused on six thematic areas: land, marine, atmosphere, climate change, emergency management, and security.

The Copernicus Land Monitoring Service (CLMS) provides information on land cover, land use, and several variables related to vegetation status at the global, European, and national scales (Apicella *et al.*, 2022). The aim of CLMS is to address the needs of a wide range of users and to support various applications related to environmental protection, management of urban areas, regional and urban planning, climate change, and agriculture and forestry, as well as water management, transport, energy or neighbourhood policy.

The CLMS provides a set of pan-European and local products.[1] The pan-European products comprise the Corine Land Cover (CLC) database, a few similar land cover datasets for urban areas ('Urban Atlas'), riparian zones and coastal areas, and a number of High Resolution Layers (HRL) providing the land cover characteristics and biophysical parameters complementing the land cover datasets (Probeck *et al.*, 2021). The HRLs have been derived from satellite images through semi-automated classification. There are currently five HRLs available: degree of imperviousness, tree cover density and dominant leaf type, grasslands, water and wetness, and small woody features (Kleinewillinghöfer *et al.*, 2022) but the number is growing. The CLMS products focused on areas that are prone to specific environmental challenges and problems, for example Urban Atlas, Riparian Zones, Natura2000, and Coastal Zones, are referred to as the local component of CLMS. The local component products are derived from a combination of a very high and medium resolution satellite images.[2]

Considering that almost three quarters (72.5%) of EU inhabitants live in cities (Eurostat, 2006) and more than a quarter of the EU territory is covered by urban land use, the management of urban areas is clearly important. One of the CLMS objectives is, therefore, to support regional and urban planning at the local level through provision of accurate, up-to-date, and reliable information about land cover, land use, and changes within the urban structure (Lefebvre *et al.*, 2016).

CLMS contributions to spatial planning were first developed as part of the Geoland project (Evans, 2007). The aim was to develop better quality data and applications than had been previously available. The expedient action was to establish an observatory for spatial planning (OSP). It aimed to combine earth observation

[1] https://land.copernicus.eu/ [accessed on: 16.10.2023].
[2] https://land.copernicus.eu/local [accessed on: 16.10.2023].

with socio-economic data in order to meet the information needs of spatial planning (Kasanko *et al.*, 2007). The OBS was terminated together with the Geoland project, but it is still an expressed aim of CLMS to support spatial planning.

Several CLMS products have a potential to directly or indirectly support urban planning. However, European countries, municipalities, and regions face different planning challenges, and requirements, and spatial planning is regulated by national legislation. Therefore, it is important to study the user uptake of CLMS products and the usefulness of the data provided by CLMS with regards to the needs and requirements in the spatial planning sector (Apicella *et al.*, 2021).

The primary purpose of this study is to identify the needs related to geospatial Land Cover, Land Use, and Land Cover and Land Use-Change information for urban and spatial planning in Poland and Norway, and to examine the usefulness of CLMS products in the planning systems. Our hypothesis is that CLMS provides data that can support spatial planning, especially decision-making, and can provide accurate, reliable, and up-to-date spatial data on actual land use and land cover.

Where other studies mainly focus on what kind of data is currently used in spatial planning, our attention is equally given to what type of data spatial planning systems would require to make better-informed decisions (Hersperger *et al.*, 2018; Sörensen *et al.*, 2021). The broader context is to explore the preconditions for an increased use of data from the CLMS in spatial planning in these two countries. We have assumed that a better understanding of metadata, ownership, and data management requirements will have universal relevance.

The specific objectives of the study are:

– Identification of similarities, differences, best practices, challenges, and requirements of spatial planning systems in Poland and Norway in terms of geospatial data;

– Examine the availability of data for urban and spatial planning regarding Land Cover, Land Use, and Land Cover and Land Use change information in Poland and Norway, and evaluate CLMS as an alternative or supplementary data source.

A comparative analysis of geospatial information requirements for spatial planning in Poland and Norway has been prepared based on a literature review concerning Land Cover (LC), Land Use (LU), and Land Cover and Land Use Change (LCLUC) monitoring. The consistency of spatial planning terminology with definitions used in the CLMS products is discussed.

2. DATA, MATERIALS AND METHODS

The research was conducted based on a comparative analysis of two European planning systems, making comparisons, and looking for conclusions and common recommendations. For research purposes, the following steps were conducted:

a comprehensive literature review, an examination of spatial planning practice, and an analysis of national and international databases on LC, LU, and LCLUC. Fig. 1 presents an overview of the research process. Cross-validation was applied through cooperation with scientists, experts, and practitioners in spatial planning; spatial databases were also explored. We have compared to what extent national planning systems and local data bases require CLMS support and to what extent CLMS data is currently used in legislative and operational urban planning. The comparative method used has been to determine to what extent national planning systems and local data bases require CLMS support and to what extent it is currently used in legislative and operational urban planning in European countries.

Firstly, international regulations, European acts, national legislation, and planning strategies were reviewed. Secondly, the spatial planning systems in Poland and Norway were described systematically to enable comparison. The map databases used in spatial planning were analysed in order to define similarities, discrepancies, and challenges in applying the existing geospatial information on land cover and land use in Poland and Norway.

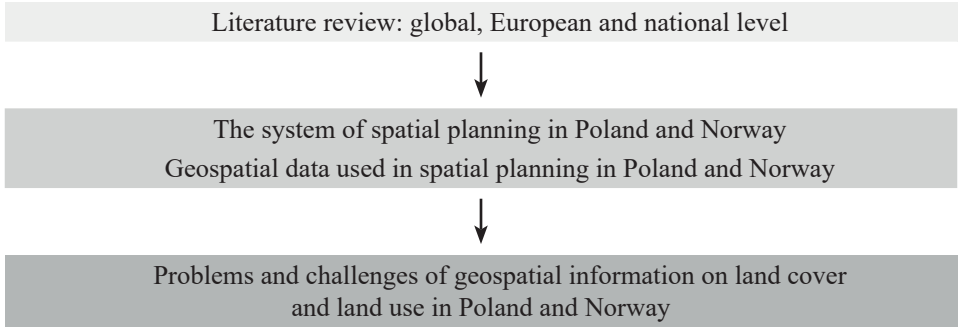

Fig. 1. Overview of the research process

Source: own work.

3. RESULTS - NATIONAL POLICIES IN POLAND AND NORWAY

The Polish Spatial Planning and Land Development Act (of 27 March 2003) has since its revision in November 2015 required municipalities to prepare development analyses and demographic forecasts. Pursuant to Art. 32 of the Act, the head of a commune, mayor or city mayor is obliged to assess the validity of the study of conditions and directions of spatial development and local spatial plans of development, including the analysis of changes in the spatial development of the com-

mune, evaluation of the progress in local plans' preparation, and develops long-term programs of their preparation in line with the arrangements of the study. It is obligatory to assess financial possibilities, keep land balance during the preparation of a study of conditions and directions, and spatial plans prepared based on studies. The Act also requires to study, calculate, and define the extent of urban development and nature. Finding such a balance is a key and an urgent need of urban planning considering the current building situation, municipality finances, plans for future growth, and the public's quality of life. These regulations may limit urban sprawl and suburban development and make local governments' planning activities more realistic.

A systemic and strategic approach shall be taken to spatial planning using hard data and monitoring urban space changes. In cooperation with the Central Statistical Office, the Polish Ministry of Investment and Economic Development coordinates the general development policy monitoring system, including developing appropriate indicators and methodologies to monitor the implementation of municipal policies. Also, the Urban Policy Observatory was established in Poland, which organises databases, conducts research, and monitors urban policy to improve it (Poland Ministry of Investment and Economic Development, 2019).

The Norwegian Planning and Building Act, in contrast, does not require any specific monitoring of land cover or land use. There is, however, a growing interest for land use accounting and a limited number of monitoring programs are in place. Furthermore, administrative routines and registers directly or indirectly imply or support land use monitoring:

– All new buildings are registered and georeferenced in the national property register (Matrikkelen).

– All new roads are registered and georeferenced in the national road database (NVDB) held by the Norwegian Public Roads Administration (Statens vegvesen).

– The local authorities are responsible for updating their base maps according to a national standard and store the data in a national database (the Collaborative Map Database, FKB).

– Municipalities must report the acreage of agricultural land reallocated to any other land use. The annual reports are submitted to the National Statistical Institute (SSB).

– Municipalities must report the number of new building permits in the coastal zone. The annual reports are submitted to the National Statistical Institute (SSB).

– The National Statistical Institute (SSB) maintains a detailed land use map, allowing it to monitor changes over time. An unconfirmed plan is to report changes every fifth year.

– A monitoring program for land cover and land use in the agricultural landscape has been operational since 1998.

– Irregular monitoring is conducted by various institutions, either as research projects or commissioned by one of the ministries. Examples include studies of

constructions in the coastal zone, leisure homes, illegal buildings, urban green areas, etc. The national Office of the Auditor General (Riksrevisjonen) also conducts projects where it investigates various aspects of the implementation of the Planning and Building Act.

– A prototype of a land use calculator has been developed, where a land use plan can be uploaded and land take is calculated by overlay with data from the Collaborative Map Database (FKB).

3.1. The system of spatial planning in Poland

Poland has a decentralised spatial planning system closely related to the hierarchy of administrative division. The administrative division of Poland has been based on three levels of subdivision since 1999. Decisions made at each level must follow any decision made at a higher level (Table 2).

Table 1. The administrative division of Poland and urban policy regulations and strategies framework

The administrative division		Planning documents	Strategic documents
NATIONAL LEVEL: STATE GOVERNMENT ADMINISTRATION		None [Until November 2020: The National Spatial Development Concept 2030 (NSDC 2030)]	The National Strategy of Regional Development 2010-20
SELF-GOVERNMENT ADMINISTRATION	**REGIONAL LEVEL: VOIVODSHIP**	The voivodeship spatial development plans	The voivodship development strategies landscape audit
	SUPRA-LOCAL LEVEL: COUNTY	planning documents at this level	The supra-local (county) development strategies
	LOCAL LEVEL: MUNICIPALITY	• The studies of conditions and directions of spatial development (SUiKZP) • Local spatial development plans (MPZP)	The local development strategies

Source: own work based on The Polish Spatial Planning and Land Development Act (of 27 March 2003).

3.1.1. National level

Urban policy regulations are set on all administrative levels except at the county level, and we can divide these regulations into planning and strategic documents. Regardless of the level of administration, all planning-related documents are based on strategic documents. The currently applicable Polish development management

system is based on the Act of 6 December 2006 on the development policy's principles.[3] The socio-economic planning system is, however, not closely linked to spatial planning. Therefore, the Polish Development Management System was adopted to create a holistic and uniform system of management and coordination of policies supporting the country's development processes (Act of 29 October 2018).

With respect to urban and spatial planning, the main legislation is the Spatial Planning and Land Development Act (Act of 27 March 2003, as amended). In addition to the above documents, Polish legislation also applies, among others: Regulation on the required scope of the study of conditions and directions for the spatial development (Act of 17 December 2021), Regulation on the required scope of the local spatial development plan (Act of 17 December 2021), The Building Code (Act of 7 July 1994, as amended), and Regulation of the Ministry of Infrastructure of 12 April 2002 on technical conditions to be met by buildings and their location.

On the national level, until November 2020, there was also the National Spatial Development Concept (the last one referred to Poland's vision for 2030). It was the most crucial long-term national strategic document concerning spatial development. It corresponded to the National Strategy of Regional Development. The document was the only formal basis for conducting a long-term spatial policy and the premise of coordinating the deployment of investments of strategic importance for Poland.[4]

3.1.2. Regional level

Voivodeships have to prepare spatial development plans and development strategies. Spatial development plans for voivodeships are the most crucial documents of voivodeship self-governments. The vision of development, goals, and objectives of a regional policy in the economic, social and spatial dimensions and the milestones necessary to achieve them are defined there.

3.1.3. Local-level

On the local level development strategies are prepared. As municipalities are fundamental units in the Polish spatial planning system, two spatial planning-related documents exist on the local level: A study of conditions and directions of spatial development (PL: "studium uwarunkowań i kierunków zagospodarowania przestrzennego", PL. abbreviation: SUiKZP) and A local spatial development plan

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[3] https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20062271658/O/D20061658.pdf [accessed on: 16.07.2023].

[4] https://www.tup.org.pl/index.php?option=com_content&view=article&id=1863%3Astanowisko-tup-w-sprawie-reformowania-planowania-i-zagospodarowania-przestrzennego&catid=131%3Aartykuly&lang=pl

(PL: "miejscowy plan zagospodarowania przestrzennego", abbreviation: MPZP). The main differences between a SUiKZP and a MPZP are presented in Table 2.

A SUiKZP determines the directions of spatial development and spatial planning policy choice at the local level (particular municipality). The study is not an act of law (not binding), so it does not constitute the basis for issuing administrative decisions. However, the findings of the study are crucial and binding for local plans.

Local plans (MPZP) are required to implement municipal spatial planning policies. The spatial development plan sets land-use rules and conditions for buildings and land on a current and future basis. Moreover, it is one of the four forms of monument protection and care, and it is an act of local law, i.e., legally binding. A particular form of a local spatial development plan may be a local revitalisation plan (PL: "miejscowy plan rewitalizacji", abbreviation: mpr). This is a tool for restoring areas from a state of critical degradation, introduced into the legal system by the Act of 9 October 2015 on revitalisation.

In the absence of a valid MPZP, a building permit may be issued based on an individual administrative decision on land development conditions and land use. It is a kind of legal gap in the Polish planning system. Therefore, a decision does not need to be consistent with the directions of a commune's spatial policy defined in the (local) study of conditions and directions, so this may thrust the cultural landscape and space into chaos. To make things worse, on the 2 January 2022, regulations were adopted which allow single-family residential buildings with a building area of up to 70 sq. m without obtaining a building permit, appointing a construction manager or keeping a construction log.

In local spatial development plans, it is obligatory to define the rules of development and spatial indicators, including the minimum percentage of the biologically active area in relation to the building plot. If the plan is not valid, the bioactive area must also result from the so-called urban analysis, which is conducted before issuing the development conditions necessary to obtain a building permit. Information on the share of biologically active surface is not directly available anywhere, it must always be calculated by an urbanist. This is especially problematic for people who are not proficient in GIS programming and have to calculate these values by hand, usually based on an orthophoto map.

Table 2. The main differences between a SUiKZP and a MPZP in Poland

Criteria	A study of conditions and directions of spatial development (SUiKZP)	A local spatial development plan (MPZP)
Objectives	A document which determines the directions of spatial development and the choice of spatial planning policy	A tool to implement municipal spatial planning policy which sets land-use, and rules and conditions for buildings and land cover

Criteria	A study of conditions and directions of spatial development (SUiKZP)	A local spatial development plan (MPZP)
Legal status	Not binding	Binding (Act of local law)
Scale	1:5,000 to 1:25,000	1:500, 1:10,00 or 1:2,000
Level of detail	A morphological region / zone	Plot / terrain / land use
Land-use division	Not specified in detail	Specified in detail
Other	According to a strict planning procedure, both documents must be prepared based on the Spatial Planning and Land Management Act; the project has to be agreed or opinioned by the Committee for Urban Planning and Architecture, regional authorities and organizations, neighbouring municipalities, etc.	

Source: own work.

3.1.4. Geospatial data used in spatial planning in Poland

The draft of a SUiKZP drawing is made on the basis of a topographic map from the state geodetic and cartographic resource or of a military topographic map. The SUiKZP is prepared on a scale from 1:5,000 to 1:25,000. The MPZP project drawing is made on a copy of the master map with an electronic signature. Planning material must be up-to-date on the day of starting the project[5].

The Head Office of Geodesy and Cartography (GUGiK) launched a collective WMS service called the National Integration of Local Spatial Development Plans (KIMPZP)[6]. Currently, in 300 units, these are vector plans, and in the remaining 993 units they are included in a georeferenced raster format. Geodetic data in Poland is subject to the Geodetic and Cartographic Law Act of 17 May 1989 (Journal of Laws of 2020 Item 276, as amended), which is regulated by the Act of 4 March 2010 on Spatial Information Infrastructure (IIP)[7] (Journal of Laws Item 177).

The most significant and crucial spatial data resources are gathered in the National Geodetic and Cartographic Resource (PL: PZGiK), which is defined in the Geodetic and Cartographic Law Act of 17 May 1989 (Art. 2(10)). For example, BDOO – General geographic objects database (PL: "Baza danych obiektów ogólnogeograficznych") and ORTO/NMT Orthophotomaps and numerical terrain

[5] the Spatial Planning and Land Development Act of 27 March 2003.

[6] Link to the service: https://mapy.geoportal.gov.pl/wss/ext/KrajowaIntegracjaMiejscowychPlanowZagospodarowaniaPrzestrzennego [accessed on: 10.05.2023].

[7] The Act on the infrastructure for spatial information was a consequence of the INSPIRE directive adopted by the European Union in 2007, establishing the European infrastructure for spatial information, and developed with the environment and its protection in mind.

model (PL: "Baza danych zobrazowań lotniczych i satelitarnych oraz ortofotomapy i numerycznego modelu terenu"). Based on Art. 40a of the Geodetic and Cartographic Law, data from PZGiK is provided at a fee. It is available at the GUGiK website (http://www.gugik.gov.pl/pzgik/dane-udostepnia-ne-bez-oplat) and can be used without any restrictions by both the administration and commercial entities.

There are three basic databases containing LULC information in Poland.

1) The Geoportal (www.geoportal.gov.pl) is considered as one of the most important as it integrates data from various sources and is the basic mapping portal for the national spatial data infrastructure.

2) The National Topographic database (BDOT10k) is available in vector format and can be obtained from the Main Office of Geodesy and Cartography. The BDOT10k topographic database provides data on the level of detail corresponding to the topographic maps at 1:10,000. The content of the database is hierarchical, there are 10 thematic classes (level 1). The Land Cover Level 1 is divided into 12 classes (Level 2), and 35 classes (Level 3). The class Land Use Complexes Level 1 contains 10 classes (Level 2), and 52 classes (Level 3).

The Land and Property Register (EGIB) database shows the division of land into types according to the actual use or development. In Poland, the land and building register, also known as the real estate cadastre, is a uniform information system for the entire country that ensures the collection, updating, and provision of information about land, buildings, and premises, their owners, and other entities that own or manage these lands, buildings, and premises. The register is updated regularly.

The register of land and buildings includes information on the following:

1) land – its location, boundaries, area, types of land use and its qualification classes, designation of land registers or sets of documents, if it has been established for the property that includes the land;

2) buildings – their location, purpose, utility functions, and general technical data;

3) premises – their location, utility functions, and floor area.

The register serves primarily to disclose the actual state of properties. The data contained in the registry forms the basis for economic planning, land-use planning, the assessment of taxes and benefits, the designation of real estate in land records, public statistics, real estate management, and farm records. Changes in the data covered by the land and building registry must be reported to the starost competent for the property's location within 30 days. The deadline is calculated from the date of occurrence of these changes (http://www.gugik.gov.pl/projekty/zsin-faza-i/dane-egib). The EGiB database stands not only as a repository of property-related information but as an indispensable tool in Poland's spatial planning landscape. Its capacity to verify residential units, utilisation patterns, ownership, and connections with land records underscores its fundamental role in fostering informed, effective, and transparent planning practices. Unfortunately, the EGIB database is not updated regularly (Jarzmik, 2020).

3.2. The system of spatial planning in Norway

Spatial planning in Norway is regulated by the Planning and Building Act (https://lovdata.no/dokument/NL/lov/2008-06-27-71). Municipalities[8] are the administrative units responsible for, and acting as the decision-making authority in local planning (Table 3). The state, represented by the government or by a county governor, is responsible for plans traversing municipal or county boundaries.[9]

Table 3. The administrative division of Norway, and related documents for spatial planning

Administrative division	Planning documents	Strategic documents
NATIONAL LEVEL: State	• Central government land-use plans (NB: usually developed by municipalities, but commissioned by central government)	• Central government planning guidelines • Central government planning provisions
REGIONAL LEVEL: County (NO: fylke)	• Regional master plan (mainly strategic, limited to a fixed period of time; not obligatory)	• Regional planning strategy (the only obligatory planning document on regional level) • Regional planning provisions (not obligatory)
LOCAL LEVEL: Municipality (NO: kommune)	• Municipal master plan: Social element (kommuneplan, samfunnsdel) • Municipal master plan: Land-use element (kommuneplan, arealdel) • Area zoning plan (områderegulering) • Detailed zoning plan (detaljregulering)	• Municipal planning strategy (obligatory to be renewed every electoral term (4 years))

Source: own work.

[8] A municipality (Norwegian: "kommune") is a Norwegian administrative unit at the NUTS 5 level in the EU statistical system. Norway has 356 (2020) municipalities. The Norwegian "kommune" is also a political and an administrative unit in the system of governance.

[9] An English translation of the part of the Planning and Building Act pertaining to spatial planning is available at https://www.regjeringen.no/en/dokumenter/planning-building-act/id570450/ The translation is for information only, i.e., it is not legally binding. An English explanation of the terminology used in the Planning and Building Act is provided by the government at https://www.regjeringen.no/no/tema/plan-bygg-og-eiendom/plan--og-bygningsloven/plan/veiledning-om-planlegging/Bokmal-nynorsk-ordliste/ordliste-norsk-engelsk--plan--og-bygning/id462717/

3.2.1. National level

"The purpose of central government planning guidelines and decisions is to safeguard national or regional interests in planning" (Art. 3-5, Planning and Building Act). Planning at the national level is the government's responsibility, and administered primarily by the Ministry of Local Government and Modernization. The ministry can set conditions for regional and municipal planning, provide guidelines and provisions, and develop a national land use plan. However, 'national' in relation to a spatial plan basically means that the plan is commissioned by the government, but still usually prepared by municipalities affected.

3.2.2. Regional level

"The purpose of regional planning is to stimulate the physical, environmental, health-related, economic, social and cultural development of a region" (Art. 3–4, Planning and Building Act). Instruments of the regional planning authorities include a planning strategy, master plans, and planning provisions.

3.2.3. Local level

The bulk of spatial planning in Norway is carried out by local (municipal) authorities. "The purpose of municipal planning is to provide favourable conditions for development and the coordinated discharge of functions in the municipality through management of the land and natural resources in the municipality, and by providing a basis for the implementation of municipal, regional, central government and private-sector activities" (Art. 3–3, Planning and Building Act).

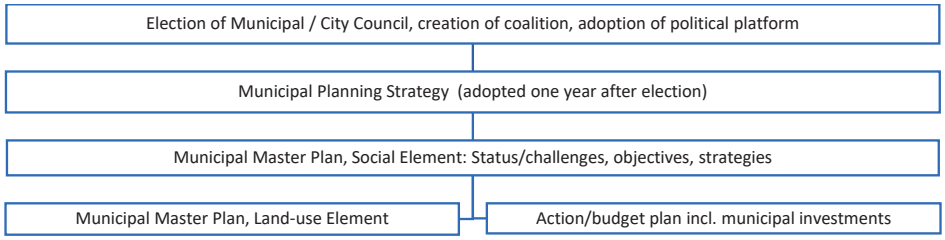

Fig. 2. Basic structure of municipal planning in Norway
Source: Aarsæther (2012), adapted and translated.

The planning instruments at the municipal level include a planning strategy, a master plan, and a number of more detailed zoning plans (Fig. 1). The munici-

pal councils (i.e., elected politicians) shall prepare and adopt a planning strategy at least once in each electoral term (4 years), and no later than one year after its constitution. The strategy shall discuss strategic choices in terms of, among others, long-term land use and environmental challenges. It shall also decide which planning documents may be prolongated, revised or prepared during the term.

Table 4. Central Norwegian planning documents on local level[10]

Criteria	Municipal master plan: Social element	Municipal master plan: Land-use element	Area zoning plan	Detailed zoning plan
Objectives	• Provide a long-term strategy for the societal development of the municipality: • Determine long-term challenges, goals and strategies, • Describe and assess alternative strategies, • serve as the basis for sector plans	• Show the connection between future social development and land use, • State the main aspects of the allocation of land and frameworks and conditions governing which new projects and new land use may be implemented, as well as which important considerations must be considered when allocating land, • Show the main objectives and areas requiring special consideration in relation to the use and conservation of land	Clarify land use in greater detail	Follow up the land-use element of the municipal master plan and, in the event, any requirements established in an adopted area zoning plan
Legal status	Binding: basis for the municipality's own activities and for the activities of the central government and regional authorities in the municipality	Binding for new projects or the expansion of existing projects	Binding for new projects or extension of existing projects	Binding for new projects or extension of existing projects

[10] https://www.regjeringen.no/contentassets/8a9cc8f0885d4f5cb9f32d1f7e3f385e/master_plan_prodspek_del1_arealplan010715.pdf [accessed on: 02.05.2023].

Criteria	Municipal master plan: Social element	Municipal master plan: Land-use element	Area zoning plan	Detailed zoning plan
Scale	None (text document only)	Normally 1:20,000–1:50,000, exceptionally 1:5,000–1:10,000	Normally 1:5,000 or 1:10,000, exceptionally 1:20,000 or 1:50,000	Normally 1:1000–1:2000, exceptionally 1:500–1:5000
Level of detail	Sector level (infrastructure, housing, business activities, municipal services (health, schools, kindergartens, cultural services), environment, etc.)	Entire municipality	Sub-section(s) of municipality	Construction project areas
Land-use division	None	Six land use categories and six kinds of consideration zones	Six types of land use categories, and 14 types of provisions	Six types of land use categories, and 14 types of provisions

Source: own work.

3.2.4. Geospatial data used in in spatial planning in Norway

Part I, Ch. 2 of the Planning and Building Act ("Requirements relating to basic map data, geodata, etc.") includes the following statements regarding responsibilities for map data available to be used in spatial planning:

– "The municipality shall ensure that there is an up-to-date, public set of basic map data for the objectives specified in the Act.

– The central government authorities shall make national map data available to all municipalities.

– Central government, regional and municipal bodies shall organize geodata in such a way as to ensure that the information is readily available for use in processing planning and building applications. The basic map data must also be available for use for other public and private purposes.

– Municipalities shall have a planning register that provides information regarding current land-use plans and other provisions that determine how land is to be used."

The authoritative collection of maps for spatial planning ("Det offentlige kartgrunnlaget", DOK) is defined in the Planning and Building Act. It is a set of national geospatial data for use in public spatial planning. National and local authorities are obliged to produce and maintain these data. The current (January 2021) list consists of 147 datasets, including detailed topographic maps, property and building registers, technical data (mainly infrastructure), and many thematic datasets.[11] The anticipated usefulness, coverage, completeness, technical quality, available documentation, and established routines for maintenance are criteria used to select the datasets on the list. Neither municipal land use master plans nor zoning plans themselves are considered part of the DOK. It is not obligatory for every municipality to use all datasets listed in the DOK. A municipality can also add other datasets (not on the master list) to its municipal DOK, provided that the additional data complies with the DOK regulation.

3.2.5. National databases containing LULC information in Norway

All geospatial data for Norway owned by national or local public authorities is available online together with the necessary metadata and product specifications.[12] The portal is maintained by the national mapping authority (Statens kartverk) and constitutes the core of the Norwegian National Geospatial Data Infrastructure (NGDI; Norge digitalt). The NGDI is mandated in the national Geodata Act and obliges all national and local public entities who produce or use geospatial data to participate in, and share their geospatial data through, the NGDI. Standardisation has been an important part of Norwegian geospatial data policy since 1991. The spatial and thematic accuracy is high and all relevant data is kept in national databases with established data management systems and routines for updating. In order to be a relevant data source for spatial planning in Norway, CLMS would need to either provide better data than currently available, data of the same quality at lower cost, or data filling known gaps in the national repository.

4. DISCUSSION

At the EU level there is no uniform policy concerning monitoring of land cover and land use change (LCLUC). It is probably possible to transform the current recommendations (Kovács *et al.*, 2013) into homogeneous guidelines for all

[11] https://www.regjeringen.no/contentassets/bdd0159c35a94b598f60398d83131df0/offisiell-dok-liste-per-2021b.pdf [accessed on: 02.05.2023].
[12] https://www.geonorge.no/

European countries precisely in the field of using monitoring data to define spatial policy, but there is no practical need for such uniformity at the national level. Conditions and challenges vary between countries, and data and monitoring requirements vary accordingly. Data standardized across Europe is, however, needed by EU authorities and other international organisations. According to the European Commission, land use and land cover data are at the basis for spatial analyses at European level (Ballin *et al.*, 2018). Similar messages and goals are being discussed at the global level (UN Habitat, 2020a; UN Habitat, 2020b; UNECE, 2018; Zhu *et al.*, 2021). The article develops the principles as such into suggestions for concrete practical solutions aiming at a better use of CLMS products.

Neither the Norwegian nor the Polish national Planning and Building Act require any specific monitoring of land cover or land use. The need for land accounting systems is, however, on the agenda. Accounting systems, and the data collected to support them, must be able to address actual information requirements and support policy development in each country. In order to provide useful information, accounting systems must be built on unbiased and reliable data. Strengthening national data series and developing management systems in order to archive copies of national registers at regular time intervals (e.g., annually) seems to be a safer approach than relying on CLMS data.

The spatial planning systems in Poland and Norway have many similarities. The administrative hierarchies are similar, and so is the allocation of spatial planning tasks and responsibilities to the administrative levels. In Poland, four levels of management can be formally distinguished, whereas three in Norway (Table 5). In Poland no spatial documents are prepared on the supra-local level and, therefore, the spatial management systems in both countries are similar. The most notable difference between Poland and Norway is the organisation and administrative routines surrounding the data availability for spatial planning.

Table 5. Administrative levels and responsibilities in spatial planning

Administrative/ political level	Poland	Norway
National	State	State/Government
Regional	Voivodship	County (NO ‚fylke')
Supra-local	County	Not formally existing, national government or county can ask for intermunicipal cooperation when appropriate
Local	Municipality	Municipality (NO ‚kommune')

Source: own work.

Table 6. Planning documents related to administrative levels

Administrative /political level	Poland	Norway
National	• No documents • [Until November 2020: The National Spatial Development Concept 2030 (NSDC 2030)]	• Planning and Building Act with regulations • Central government planning guidelines • Central government planning provisions
Regional	• the voivodeship spatial development plans	• Regional planning strategies • Regional master plans • Regional planning provisions
Supra-local	• No documents	• No formal planning level with documents, however intermunicipal planning cooperation can be encouraged
Local	• the studies of conditions and directions of spatial development (SUiKZP) • local spatial development plans (MPZP) – legally binding documents • administrative decisions on development conditions	• Municipal planning strategies (‘Kommunal planstrategi’) • Municipal master plans: (‚Kommuneplan’) consisting of two parts Social element (‘Samfunnsdel’) Land-use element (‚Arealdel’) • Zoning plans (area) (‚Områderegulering’) • Zoning plans (detailed) (‚Detaljregulering’)

Source: own work.

4.1. Potential of CLMS products in national spatial planning

Spatial planning in Poland and Norway is functional, and the provision of planning documents relates to specific land uses. CLMS products and BDOT/ EGIB refer to land coverage unless individual categories can be linked with the existing share of biologically active area (green area ratio), an obligatory urban indicator in local spatial development plans in Poland.

Poland’s planning documents refer to the target development vision, except of the conditions which are part of the study of conditions and directions from the city. CLMS data does not meet national standards with respect to geometric accuracy, and the thematic accuracy is also variable (Strand, 2022). CLMS products can be used as a source of information in this area for evidence-based

decision-making or to verify to what extent the plan arrangements have been materialised, at least as long as the quality is considered acceptable. This is not the case in Norway. Instead, a national map of green and grey areas is produced for this purpose.

CLMS products can be a source of knowledge for urban planners in terms of where urbanization occurs and its level of advancement. There will, however, be cadastral data, building registers and detailed maps used in the development and implementation of construction projects. These sources provide more detailed and accurate information than CLMS products, and can be useful in spatial planning and land monitoring, provided that they are standardised and collected in a central repository.

There is often a time lag between the implementation of development projects and the updating of official maps and registers. The CLMS could fill this gap by providing information about recent developments that are not yet documented in the registers. Such an approach would require a data management regime capable of temporarily updating registers using recent CLMS data, and later replacing this information by field data when those have become available.

CLMS products could also be a source of information about the development of space in the share of individual surfaces in the road space (asphalt/ concrete/ sidewalk/ greenery), in situations where this information is absent in the registers provided by national road authorities. It would, however, require levels of geometric and thematic accuracy that are rarely seen in current CLMS products.

The use of CLMS data as a supplementary resource for updating land and building registers would require careful consideration: while CLMS data could provide valuable insights into land cover dynamics, its limited detail and lack of geometric and thematic accuracy question its viability as a standalone tool for spatial planning decisions. Though a CLMS could serve as a landscape trend indicator, its lack of detailed information might hinder direct use in spatial planning. Nevertheless, integrating CLMS data within a broader framework, alongside more detailed data sources, could enhance the updating of land and building registers. While not ideal for direct spatial planning decisions, CLMS data's role as a complementary source can contribute to a more comprehensive approach to spatial data management and analysis. The CLMS could be a source of knowledge about spatial developments (e.g., a new building, the extension of an existing building, demolition, etc.) and thus indicate a need to verify the purpose and detailed classification to supervisory institutions.

Norway has a national map portal (www.geonorge.no) providing spatial planners with access to relevant land use and land cover information stored in national databases. In Poland, there is no such central database offering similar access to different spatial information in one portal. Users of spatial databases in Poland lack a publicly available map of the country's land use and land cover, presenting

both the current level of development and archival versions allowing users to compare situations with regard to detect changes over time. What would be desirable is a portal that would integrate: high-resolution data, land contours, soil and agricultural maps, information on urban heat islands, and data on social processes as registered by Statistics Poland.

It is also important to highlight that spatial planning would need a reliable and user-friendly tool, which would help planners harmonise and combine various datasets on land cover, land use, and changes.

5. CONCLUSION

Spatial planning systems in Poland and Norway have similar policy objectives. The planning system in Norway seems to be more orderly, if only because it does not provide for personal administrative decisions on development conditions, which may be issued contrary to the city's spatial policy and are considered a spatial pathology in Poland. Data availability also differs between the two countries. National repositories and access policy seem to be more organised in Norway, with a formal spatial data infrastructure developed and managed under a national Geospatial Data Act that secures public authorities, including spatial planners, and access to data across sectors.

National, European, and global bodies indicate the need for reliable spatial data and continuous monitoring of spatial planning, land use and land cover, and their change. Moreover, European and global bodies require data to be harmonised and comparable for larger regions involving many countries. Planners need similar data to make evidence-based informed decisions, but they do not depend on international standardisation. It is more important that data meets national requirements.

Official national data is reliable and usually very detailed. In Norway, they also include elements of development that were created without a proper building permit or are at the initiative of the property owner, usually identified on aerial photographs obtained through regular surveys. In countries without such a detection system, the CLMS can potentially be a tool to provide information for spatial planning by filling gaps in national registers. Delayed updating of public registers can also be relieved through temporary updates using CLMS data, provided that it is replaced by more detailed or accurate data upon availability.

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