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The Backlog of Cadastre Records of Older Cases Conducted by the Land Consolidation Court in Norway

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Abstract. *This article aims to elucidate the reasons for the lack of cadastre registration of older cases conducted by the land consolidation court in Norway. The cadastre’s increasing role in society requires the cadastre to be updated, among other things, after a land consolidation process. In order to assess the reason(s) for the backlog, a questionnaire survey was conducted and statistically analyzed. In addition, free text answers from the survey were analyzed and synthesized by using content analysis. The current study reveals that many Norwegian municipalities do not have an overview of how many older cases conducted by the land consolidation court there are within the municipality. Furthermore, the reason for the lack of cadastre registration of older cases conducted by the land consolidation court seems to be that, the cases were never handed over to the municipalities for their cadastre records. Moreover, it is a time-consuming, as well as highly complex, process to register these cases in the cadastre. The article’s contribution to the field is two-fold. Firstly, the study provides insight into Norwegian conditions regarding land consolidation and cadastre records. Secondly, the article contributes to an ongoing debate in Norway about improving the quality of the cadastre. The study has limitations, as the survey sample was not a result of randomized sampling. Nevertheless, the data obtained give a picture of the current backlog in the registration of older cases carried out by the land consolidation court and how it effects the society and the public in general.*

Keywords: *cadastre, land administration, land consolidation, Norway*

1 Introduction

Reports show that Norway is facing difficulties with the cadastre registration of “older” cases conducted by the land consolidation courts (PureLogic, 2019, p. 14). This article considers, “older cases” to be cases conducted before the Act on a national register for land information (Cadastre Act) came into force in 2010. A cadastre system aims to describe an area’s current real property division.

Riekkinen et.al (2016) define a cadastre as “...a systematic, public and up-to-date register which contains information about real properties and cadastral units corresponding to them in a certain area” (Riekkinen et al. 2016, p. 704, Henssen, 1995). According to Enemark (2012, p. 1), the cadastre system is a “back bone in society”, meaning that a well-functioning cadastre system provides security of property rights. Also, cadastre information shall be communicated to society because of its role as a shared component of the public information infrastructure. Shared components are building blocks that public services benefit from while developing digital services (Meld. St. 27, 2015–2016, p. 76).

By using the tool of land consolidation, the structure of agricultural holdings and farms can be improved. Increasingly it is also applied to urban land use. This can contribute to increased economic and social efficiency. Both real property owners and society in general can benefit from this effective tool. In Norway, land consolidation is defined as measures that can change properties, physically or organizationally, to improve their utility to the owners (Sky and Bjerva, 2018, p. 21). “A fundamental principle, and not only in Norway, is that no party shall suffer losses as a result of a land consolidation case” (Sky and Elvestad, 2019, p. 65). To obtain the many benefits from cases conducted by the land consolidation court, the results of the cases must be recorded in the cadastre.

This article provides insight into, and analyses, a problem that is stated in two research questions (*RQ 1*): *What is the reason for the lack of cadastre registration of older cases conducted by the land consolidation court in Norway?* Furthermore, an attempt is made to identify the effects of the problem (*RQ 2*): *What are the effects of the lack of cadastre records of older cases conducted by the land consolidation courts?*

The theoretical framework of the paper is, as several other studies about cadastre or land consolidation, the theory of land administration, and more generally institutional theory (see e.g. Arrunada, 2012 and Libecap, 2011). «Land administration» is defined as «the processes of determining, recording and disseminating information on ownership, value and use of land when implementing land management» (UN, 1996, p. 108). A reliable land information system has its benefits, and the land administration system aims to outline these benefits (see Williamson et. al., 2009 for more details about land administration and sustainable development). In this paper the theory is used to discuss how land administration affect land change through land consolidation processes, and the cadastres fundamental role in society.

Mixed methods was used to obtain data. By conducting a questionnaire survey, data were obtained from people working with cadastre records (quantitative method). Two literature studies provided important contributions to enlightening the paper (qualitative method). Through the first literature study, I got an overview of land consolidation and cadastre in Norway. Based on the literature reviews, it can be said that there is an international focus to link land consolidation and cadastre to sustainable development and the UN 2030 Sustainable Development Goals. The purpose of the second literature review was to connect land consolidation

and/or cadastre in Norway to this international trend, as seen in e.g. Veršinskas et al (2020), Morales et al (2021), and Bennett et al (2021).

This paper consists of five sections. Section 2 presents a brief presentation of land consolidation and cadastre registration in Norway, based on a literature review. Thereafter, the methodology is clarified, and the respondents are evaluated in Section 3. Section 4 shows the findings, and the results of the analyzes of the data from the questionnaire survey. Then, Section 5 discusses the findings in relation to existing literature and other surveys. Finally, Section 6 draws conclusions.

2 Framework

The design of a cadastre system depends on each country's history and cultural development. The cadastre's increasing role in society requires the cadastre to be updated, among other things, after a land consolidation process. The organization of land consolidation also differs between countries, largely because of their origins. There follows a brief overview of cadastre registration and land consolidation in Norway.

2.1 Land Consolidation and Cadastre Registration in Norway.

The Norwegian system for property registration consists of two public subsystems: the cadaster (object register) and the land register (rights register). The cadastre is the topic of this article, but it must be mentioned that the two registers are functionally connected (Gammelmo, 2017). The registers shall capture the actual property conditions and changes in the property conditions. The key information in the land register is the rights in, and the rights holders of the real properties (Williamson et al., 2009, p. 51). The person who is listed as the right holder in the land register have full ownership of the real property and is given legal protection. In this context "legal protection" means that rights and ownership is protected against others that claims the same or contrasting rights. The land register is regulated by the Act on land registration (Land Registration Act).

If the land register contains inaccuracies in Norway, the state may risk receiving a claim for compensation, cf. the Land Registration Act section 10 and the Act relating to procedure in cases concerning the public administration (Public Administration Act) section 36 first and third paragraph. The same requirement is not set for security of ownership in the cadaster (NOU 1999, p. 19). Security of ownership in the cadaster is a major topic and outside the scope of this article. More information about the reason why the cadaster in Norway does not contain the same same requirement for security of ownership that the land register contains is available in NOU 1999:1.

The cadastre essentially contains information about real property, but also some information about the landowners. What the cadastre must contain is stated in the Cadastre Act section 4 paragraph one and two: "...*information about the individual cadastral parcel that is necessary for planning, development, use and protection of real estate, including official designations and information about each building, dwelling and address. The cadastre shall show the boundaries of the cadastral parcels, including boundaries of outdoor areas included in*

the condominium units. The cadastre shall contain information about orders concerning the use of land or buildings on the cadastral parcel concerned.”

The cadastre system In Norway consists of: “... *software, data tables, data models, documentation, etc. which together make the cadastre appear as a functioning computer system, i.e. with the possibility of entering and extracting data and exchanging data with other registers.*” (Ministry of Local Government and Modernisation, 2021, p. 10). In this article, the cadastre system is also referred to as a “technical system”.

The purpose of the cadastre map in Norway is in the first place to contain detailed data about boundaries as far as these are concerned. However, the cadastre map in Norway contains boundaries with differences in accuracy. The cadastre map was not introduced to show legal binding property boundaries (Ot.prp.nr.70, 2004–2005, p. 58). Most important are the boundary marks in the field. Other available information must be used if the marks are missing, such as measurement data or information from the parties. The cadastre map acquires probative value only if no better information is available (Ot.prp.nr.70, 2004–2005, p. 54). Still, cadastre data shall be publicly available. This means that actors who need information about real property should not be unaware of information that, at the relevant time, was registered in the cadastre (Ot.prp.70, 2004–2005, p. 48). Hence, it must be argued that the cadastre must be updated with the results of legal proceedings at the land consolidation courts, as the society depends on it. What landowners and the public see in the field, should be reflected in the cadastre.

Although the cadastre and the land register is functionally connected, this does not mean that they have always been well coordinated (Sevatdal, Sky and Berge, 2017, p. 232). One observation from the literature study was that seen in a historical perspective, registration in the land register was more mentioned than cadastre registration. In connection with land consolidation, there has been more focus on documenting ownership and rights, as this has been in the parties’ interest. Less emphasis has been given to the conditions reflected in the cadastre and the cadastre map (Mjøs and Sevatdal, 2011, p. 166).

In Norway, the municipalities (the local cadastre authorities) are responsible for carrying out land surveying and updating cadastre records. By agreement, the municipality may hand over the cadastre records to another municipality or to the state through the Norwegian Mapping Authority (the central cadastre authority), cf. the Cadastre Act, Section 5, second paragraph. The Norwegian Mapping Authority is responsible for the arrangement, operation, and management of the cadastre, cf. the Cadastre Act, Section 5, first paragraph. It is the responsibility of the Norwegian Mapping Authority to conduct training and approval of those who are to implement cadastre records in the municipalities (Ot.prp.nr.70, 2004–2005, p. 67).

Land consolidation is preferably required by one or more landowners who will later become parties to the case. Land consolidation is carried out by the land consolidation court. In this specialized court, a land surveyor employed by the court performs the survey work, while a land consolidation judge makes the final decision or judgement. The competences of the land consolidation court can be summarized in four main groups, cf. Land Consolidation Act, Section 1-4. Relevant

to this article are cases in accordance with the Land Consolidation Act section 1-4: “Land consolidation cases” (and “project related land consolidation”) cf. Chapter 3; “Legal clarification cases”, cf. Section 4-1; and “Boundary determining cases”, cf. sections 4-2 and 4-3.

It is of relevance to this article that the cadastre was designated one of seven shared components in Norway’s national infrastructure in 2010. Through access solutions, cadastre data was made accessible to the public administration, financial institutions, the public and others. In this way, it became possible to share geographical information more easily.

Due to its position as a shared component, the cadastre has a central role in society. The cadastre has been built up over a long period of time, and the data it contains has been obtained through various processes, including through cases carried out by the land consolidation courts. A result of this is that one and the same data field may contain different information, depending on the historical time period in which data was collected, and due to variations in methods, processes, and intended use. Due to this, cadastre data in Norway is often referred to as being of “poor quality”, or at least varying quality (Pure Logic, 2019, p. 6). Therefore, the Norwegian Mapping Authority initiated a project. The purpose of the project was to improve the quality of the cadastre and ensure that it maintains a proper technological level and operates well as a national shared component. An economic analysis has assessed whether given measures to increase the quality of the cadastre are profitable to society (Pure Logic, 2019, p. 8). Cases carried out by the land consolidation court are one of several issues mentioned in connection with the quality improvement project. In 2020, the land consolidation courts completed a total of 1,265 cases, and 1,373 new cases were demanded (Norges Domstoler, 2020). Every new case that has been demanded and every case that has been closed had to be reported to the municipalities, cf. sections 46 and section 47 of the cadastre sections. A total of 1,290.4 kilometers of borders were measured, and a total of 1,480 border points were measured in 2020 (Domstoladministrasjonen, 2021, p. 2).

It has been pointed out that some old cases conducted by the land consolidation courts have not been entered in the cadastre, so the cadastre has not been updated with the latest judgment (Pure Logic, 2019, p. 14). Although cadastre registration of older cases carried out by the land consolidation courts is a small part of the quality improvement process, it would make an important contribution. Economic analysis does not address the question of why such a backlog has arisen in the registration of older cases carried out by the land consolidation courts. As previously stated, that is the topic of this article.

Furthermore, the Act on an infrastructure for geographical information (Spatial Data Act), Section 1 states: “*The Act shall promote good and efficient access to public geographical information (spatial data) for public and private purposes*”. Both the municipalities and the Norwegian Mapping Authority are required to participate in infrastructure for geographic information, cf. the Spatial Data Act, Section 4. It follows from the sections on infrastructure of spatial data infrastructure, Section 1, second subsection that the land consolidation courts have

to participate in geographic information infrastructure, as they produce specified geodata, cf. the Spatial Data Act, Section 4 (Regjeringen, 2019).

3 Research design

Data from two literature reviews were linked with empirical data obtained by a questionnaire survey. In addition, data from the literature studies were used as background material. To begin with, two systematic literature reviews were designed and conducted. Through stepwise searches, articles relevant to this article were identified.

The following databases were used to acquire literature in the first literature review: Web of Science, Scopus, Oria, and Nasjonalbiblioteket. Additionally, to identify additional relevant studies not indexed in the database search, the handsearching technique was utilized: reference lists were screened. Searches for authors found in the referent lists were completed by searching in e.g., Google Scholar or Research Gate.

The purpose of the first literature review was to provide answers to the following three questions: Who forms the basis for cadastre records in Norway?; Who updates cadastre records in Norway?, and; Who organizes land consolidation in Norway?

By using this method, bias was reduced, and the replicability of the review was strengthened. Nevertheless, the systematic literature review was time-consuming and grey literature was not included. The results of the review were given in section 2.

The extracted material was analyzed and synthesized by using content analysis. The methodological quality of the studies obtained was assessed using critical appraisal tools. Finally, a snowballing technique was utilized, as primary data sources, like search terms used in database searches, or reference lists, refers to more potential data.

In the second literature review, relevant literature to this article was essentially *not* identified. I used the same techniques and searched in the same databases as I did in the first literature review. I even contacted experts to gain relevant public documents. The only literature I got from the experts was the article I already found in the database search, which confirmed that sustainability is not highly emphasized in connection with land consolidation in Norway. The article identified was “Jordskifte og FNs bærekraftmål” (*Sky and Lyng, 2020*). The case law also seems to place little emphasis on sustainability, as only 4 of 1,466 cases from the land consolidation courts, found through database searches, mention sustainability.

The purpose of the second literature review was to connect land consolidation and cadastre records to sustainability. Sustainability is central to the international agenda, which is reflected in, among other things, the UN’s sustainability goals and in the literature.

3.1 Questionnaire survey

The empirical basis for this article is data collected as part of a national online questionnaire survey in Norway from the end of November 2020 until the end of January 2021. The aim of the questionnaire was to uncover knowledge about, and experiences of, the cadastre registration of older cases conducted by the land consolidation courts. The group of respondents relevant to the survey was those people working with this kind of cadastre registration (all municipalities).

The questionnaire was developed based on the results of an economic analysis (2019) of the quality of the cadastre in Norway. Also, the findings of an interview survey from 2020 about cadastre registration of cases conducted by the land consolidation court indicated that cadastre records of older cases can be challenging to register in the cadastre (Trygstad, 2020). First, a pilot survey of the questionnaire was conducted. Five people with experience of cadastre registration of cases carried out by the land consolidation court answered the questions in the pilot questionnaire. The feedback from the participants led to changes in structure and wording of the final questionnaire. Then, the questionnaire was sent to the municipalities. The questions relevant to this article can be found in Appendix 1.

The respondents were addressed via an inquiry to the Norwegian Mapping Authority, which has an overview of everyone who conducts cadastre registration. In most municipalities, there is only one person who updates cadastre records. Thus, it was not difficult to select respondents. However, there are several people conducting cadastre registration in some municipalities. In these cases, one of them was randomly invited to participate in the questionnaire survey.

To reduce the problem of non-response, the respondents were reminded about the survey three times during a period of three months. After three reminders, those respondents who didn't answer were sent a request asking whether or not they were involved in recording cases conducted by the land consolidation courts in the cadastre. If they were not, a request was made for the contact information of the person who was. The invitation was updated in the questionnaire survey as feedback was received.

There are a total of 356 municipalities in Norway (2021). As some municipalities don't carry out their own cadastre registration, the lists of municipalities received from the Mapping Authority contained contact information for possible respondents from 354 municipalities. In total 160 out of 354 people invited to take part of the questionnaire survey answered the questions. This gives a response rate of 45.2 percent. The questionnaire survey was a result of a non-probability sampling. Therefore, it is not possible to generalize the results of the survey. However, the questionnaire survey provides insight into challenges some municipalities face regarding the cadastre registration of old cases conducted by the land consolidation courts. Also, the validity was strengthened as 45 percent of the respondents had worked with cadastre records for more than 15 years.

In addition to the nominal and ordinal level questions, question 25 of the survey invited free text answers. Hypotheses were tested based on the data collected. The survey data was analyzed with IBM SPSS Statistics version 27. The most important methods for analyzing the survey data were descriptive

statistics (frequency, central tendency assessments, and cross-tabulations) and statistical tests (t-test, Kruskal Wallis 1-way ANOVA test). Data were described by descriptive statistics, such as measurement of frequency, and correlations between variables were made (Field, 2013, p. 381). The purpose of using the paired t-test was to test whether the average value between two data sets was significantly different from the null hypothesis (Jacobsen, 2018, p. 371). Furthermore, the most common statistical test for cross-tabulations is the chi-squared test. Due to cross-tables with many cells with few observations, the chi-squared test could not be used in this case. It can be assumed that the chi-squared test would have given misleading results. The Kruskal Wallis 1-way ANOVA test is used to investigate whether 3 or more samples or categories come from different populations (have the same average). H0: The categories have the same average. H1: The categories have different averages (Israel, 2008, pp. 92–95). The problem is that K-W one way ANOVA similarly as ordinary ANOVA basically only shows that one or more categories have a different average than the total average, but we do not know which category or categories that stand out (Field 2013, p. 238). To find out, we must perform pairwise K-W tests, which show those categories that stand out. However, several tests on the same data increase the risk of so-called type 1 error (false positive). Therefore, a Bonferroni correction is normally made in paired K-W tests. The Bonferroni correction is conservative, and the result is often that results that were previously significant ($p < 0.05$) do not become significant ($p > 0.05$).

Traditional statistics based on hypothesis testing in principle follow a kind of black-and-white logic. Either the hypothesis holds or is rejected. Modern statistics instead often examine so-called effect sizes, which are a measure of the effect in a population (Ellis 2010, p. 5–24). According to Cohen (1988, p. 40), the effect sizes can be divided into the categories small, medium, and large. What is a small, medium or large effect size depends on the type of statistical tests and what are the relevant measures for the effect size. For many effect sizes measures, the limits are often 0.1 for small, 0.3 for medium and 0.5 for large effect size, respectively.

3.1.1 Questionnaire respondents

Table 1 provides an overview of the characteristics of the respondents. It shows how many years of experience the respondents have with cadastre records, the size of the municipality in which respondents are employed, and the number of residents in the municipalities.

Various technical solutions have been developed for updating cadastre records with information about cases carried out by the land consolidation courts. The results show that the municipalities use different solutions and a combination of solutions (Q7 see Appendix 1). The difference between the technical solutions is that they are made available by different vendors, and they have slightly different user interfaces and functionality. In total 69 respondents (43.1 per cent) used the technical solution developed by “Norkart Geoservice AS” (GISLINE) for cadastre records in general (both new and old cases), 44 respondents (27.5 per cent) used both the solution from Norkart Geoservice AS and the solution created

Table 1. Characteristics of the respondents in the questionnaire survey.

Years of experience with cadastre records		Size of municipality in km ²		Number of residents in the municipality	
	N (%)		N (%)		N (%)
15+	71(45)	2,500+	20(12)	150,000+	3(2)
11–15	24(15)	1,500–2,500	22(14)	50–149,999	11(7)
6–10	37(23)	1,000–1,500	17(11)	20–49,999	24(15)
3–5	13(8)	500–1,000	36(22)	10–19,999	24(15)
0–3	15(9)	0–500	60(38)	5–9,999	35(22)
		Don't know	5(3)	0–5,000	63(39)
Sum	160(100)		160(100)		160(100)

by the Norwegian Mapping Authority, 28 (17.5 per cent) used the solution from the Norwegian Mapping Authority, 11 (6.9 per cent) used both the solution from the Norwegian Mapping Authority and the solution developed by “Norconsult information system”, and 8 respondents (5 per cent) used the technical solution from “Norconsult information system” for recording cases conducted by the land consolidation court in the cadastre.

In response to the questionnaire’s Q8 (see Appendix 1), 97 respondents (60 per cent) answered that they were satisfied with the technical solution their municipality used for recording cases conducted by the land consolidation courts, 38 (24 per cent) were neutral, 15 (9 per cent) were very satisfied, 9 (6 per cent) were dissatisfied and one (1 per cent) was very dissatisfied with the solution. On a scale of 1–5, where 1 = very dissatisfied and 5 = very satisfied, descriptive statistical analysis showed that those on average most satisfied with the technical solution were those using the solution developed by Norkart Geoservice AS ($M = 3.99$, $SD = 0.47$). Those using “Norconsult information system” were second most satisfied ($M = 3.88$, $SD = 1.126$), even if there were significant variations in the respondents’ answers. Next, those using both “Norconsult information system” and the Norwegian Mapping Authority’s technical solutions for keeping cadastre records ($M = 3.73$, $SD = 0,786$) were more satisfied than those using only the technical solution from the Norwegian Mapping Authority alone ($M = 3.61$, $SD = 0,737$). However, those who were least satisfied were those using both the Norwegian Mapping Authority’s technical solution and Norkart Geoservice’s solution ($M = 3.36$, $SD = 0,84$).

4 Findings and analysis

This section provides insights into the respondents’ opinions on the possible reasons for the backlog in the registration of older cases conducted by the land consolidation court in the cadastre. To investigate research question 1, four hypotheses were assessed. First, the hypothesis is presented. Then, the hypothesis is tested by examining whether or not the assumptions in the research question can be rejected.

Hypothesis 1 was formulated as follows:

Hypothesis 1: *The technical system (the cadastre system) is the reason for the backlog in the registration of older cases carried out by the land consolidation courts.*

Furthermore, regarding challenges in connection with cadastre registration, it can be asked whether older land consolidation cases may be more challenging to register in the cadastre than older legal clarification cases and older boundary determination cases in Norway. Some land consolidation cases cover a large area. There can be many parties to such cases. Everyone affected by the cadastre registration must be recorded in the cadastre. At the same time, it must be ensured that those who are not parties are not recorded as parties either. One example of cases that are demanding is project-related land consolidation. On the other hand, the reality can be very different from what the cadastre map shows in legal clarification cases and boundary determination cases. There can be extensive work involved in registering these kinds of cases where the information you have to base yourself on is inaccurate. Furthermore, in boundary determination cases, polygons must be closed in the cadastre. Because of the principle of party control, the parties are free to dispose their claims. Sometimes, the claims don't involve real property that should be involved to be recorded later. This issue is discussed in Trygstad (2020). Based on this, the following hypothesis was derived:

Hypothesis 2: *It is more challenging to register older "land consolidation cases" in the cadastre than it is to register "legal clarification cases" and "boundary determination cases."*

Additionally, it appears from the economic analysis that many municipalities have a shortage of resources. Cadastre records for cases conducted by the land consolidation courts require a lot of resources because of their complexity (Pure Logic, 2019, p. 29). In this context, resources mean time, employees, competence, and costs. There is no known reason to suggest that this should not also apply to older cases. Again, this gives rise to two further hypotheses:

Hypothesis 3: *The backlog in the registration of old land consolidation cases can be explained by the cases' complexity.*

Hypothesis 4: *The backlog in the registration of old legal clarification cases and old boundary determination cases can be explained by the cases' complexity.*

4.1 What is the reason for the lack of cadastre registration of older cases conducted by the land consolidation courts in Norway?

This section will focus on the respondents' opinions on the reason for the lack of cadastre registration of older cases conducted by the land consolidation courts in Norway. First, it should be emphasized that cases vary in scope. Since the purpose of the survey was to count and classify rather than study individual cases in depth, I have no insight into their content.

Table 2. Descriptive frequency analysis: Older cases conducted by the land consolidation court in the municipalities that still are not recorded in the cadastre.

Number of cases	Frequency	Percent
None	67	41.9
1–4	20	12.5
5–10	4	2.5
11–20	1	0.6
> 20	1	0.6
Don't know	67	41.9
Total	160	100

Table 2 shows how many older cases within the municipalities are not yet recorded in the cadastre. All these cases were conducted by the land consolidation courts. Most respondents stated they didn't have any unrecorded older cases carried out by the land consolidation courts in their municipality (42 per cent). However, an interesting finding is that 67 out of 160 (N) respondents answered that they did not know how many older cases in their municipality that were still not recorded in the cadastre. This constitutes the same number of respondents who answered that they had no backlog in the registration of older cases conducted by the land consolidation courts.

The lack of information about whether or not older cases carried out by the land consolidation court had been recorded was elaborated on by a respondent in answer to question 25. The respondent wrote that several older cases carried out by the land consolidation court had not been sent to the municipality from the land consolidation court. As an example, he wrote that he had recently discovered that the result of a case from 1979 had not been handed over to the municipality. Hence, it was still not recorded in the cadastre. Another respondent wrote that the municipality had around 50 cases with quality issues and other deficiencies that they knew about. Whether any of these cases were conducted by the land consolidation court was unknown. However, what the respondent did know was that some real properties appeared as parties in cases conducted by the land consolidation court in the old property register, which was digitized to produce today's cadastre. Furthermore, the respondent wrote that after a review of the so-called SOSI-files sent by the land consolidation court later, this turned out to be incorrect. SOSI-files are described in Kartverket (2021).

Based on the respondents' answers (Q26), the technical systems for the cadastre registration of older cases conducted by the land consolidation court can be considered user-friendly ($M = 3.41$, $SD = 0.82$). The respondents who answered they had no backlog in the registration of older cases carried out by the land consolidation courts also predominantly responded they were neutral to the technical solution's user-friendliness, or they thought the technical solution was user-friendly. A Kruskal Wallis test showed there was no statistically significant association ($p = 0.498$) between the technical system (Q26) and the backlog in the cadastre registration of old cases carried out by the land consolidation courts

Table 3. The associations between older cases conducted by the land consolidation courts not registered in the cadastre within the municipalities and land consolidation difficulties.

Land consolidation difficulties (Q23)	Older cases not recorded in the cadastre within municipalities (Q22)					Total
	None	1–4	5–10	11–20	Total	
To a very small extent	5	1	0	0	6	
To a small extent	8	3	0	0	11	
Neutral	13	4	1	0	18	
To a large extent	3	4	2	0	9	
To a very large extent	1	3	1	1	6	
Total	30	15	4	1	50	

(Q22). Thus, the technical systems’ user friendliness is not the reason for the backlog in the registration of older cases carried out by the land consolidation courts. Hypotheses 1: “*The technical system (the cadastre system) is the reason for the backlog in the registration of older cases carried out by the land consolidation courts*” was thus rejected.

Furthermore, the respondents answered question 23 and question 24 pretty much equally (mean difference = -0.04). A paired t-test showed there was no significant difference between question 23 and question 24 ($p = 0.41$). Thus, based on the respondents’ answers it can be concluded that it is not more challenging to register older “land consolidation cases” in the cadastre than it is to register older “legal clarification cases” and “boundary determination cases”. Hence, hypothesis 2: *It is more challenging to register older “land consolidation cases” in the cadastre than it is to register “legal clarification cases” and “boundary determination cases”*, was also rejected.

Since the technical system is not the cause of the backlog in the registration of older cases conducted by the land consolidation courts, there must be another explanation. Hypotheses 3 stated that “*The backlog in the registration of old land consolidation cases can be explained by the cases’ complexity*”.

Table 3 show the association between Q 23 and Q22, depending on how many older unregistered land consolidation cases is with the municipalities. In this case, the Kruskal-Wallis test shows that the 0 hypothesis (that the different categories have equal averages) can be rejected ($H(3) = 10.556, p = 0.014$). Regardless, it’s not known which of the categories stand out. To find out, a paired Kruskal-Wallis test was used. The paired test shows that there is a significant difference ($p = 0.043$) between the category “none unregistered older cases” and “1–4 unregistered older cases”. With Bonferroni correction these changes ($p = 0.43$), became non-significant. In a paired test between “none older unregistered cases” and “5–10 older unregistered cases”, there is a significant difference ($p = 0.019$), but even this difference changes to none-significant ($p = 0.186$) with Bonferroni correction. An alternative is therefore to examine the effect size of these relationships using the effect size r , which is calculated as a z-score divided

Table 4: The associations between older cases conducted by the land consolidation court not registered in the cadastre within the municipalities and difficulties regarding legal clarification cases and boundary determination cases.

Legal clarification/ Boundary determination difficult (Q24)	Older cases not recorded in the cadastre within municipalities (Q22)				
	None	1–4	5–10	11–20	Total
To a very small extent	4	0	0	0	4
To a small extent	8	2	0	0	10
Neutral	13	3	1	0	17
To a large extent	3	6	2	0	11
To a very large extent	1	3	0	1	5
Total	29	14	3	1	47

by the square root of the total number of respondents in the two categories being compared (Field, 2013, p. 248). In the pairwise comparison between “none” and “1–4” unregistered older cases, there are a total of 45 respondents. The z-score is -2.024 . This give $r = -2.024 / \text{square root of } 45 = -0.30$. According to Cohen (1988, p. 80) this is a medium strong effect size. The pairwise comparison between “none” and “5–10” unregistered older land consolidation cases have a $r = -0,40$ medium- sized effect size on how demanding it is to register these cases. In this case, with land consolidation cases, it is the changes from “none” to “1–4” and “5–10” unregistered land consolidation cases that affect how demanding it is to register these cases. Thus, hypothesis 3 was supported by the statistical analysis: The backlog in the registration of old land consolidation cases can be explained by the cases’ complexity.

Hypothesis 4 claimed that “*The backlog in the registration of old legal clarification cases and old boundary determination cases can be explained by the cases’ complexity.*”

The results from the association between question 22 and question 24, depending on how many older unregistered legal clarification cases and unregistered boundary determination cases is with the municipalities, is shown in table 4. In this case too, the Kruskal-Wallis test shows that the 0 hypothesis (that the different categories have equal averages) ($H(3) = 13,323$, $p = 0.004$) can be rejected. But we do not know which of the categories stand out. To find out I used a paired Kruskal-Wallis test. The pairwise tests show that after the Bonferroni correction, there is a significant correlation ($p = 0.023$) between “none” and “1–4” unregistered older legal clarification cases and boundary determination cases. Similarly, after the Bonferroni correction, there is no significant difference ($p = 0.879$) between “none” and “5–10” unregistered older legal clarification cases and boundary determination cases. A control of the effect sizes for “none” versus “1–4” older unregistered legal clarification cases and boundary determination cases ($-3,053 / \text{square root of } 44$) and “none” versus “5–10” unregistered older legal clarification cases and boundary determination cases ($-1.707 / \text{square$

root of 32) show that $r = -0.46$, that is an almost large negative effect size for “none” versus “1-4” older unregistered legal clarification cases and boundary determination cases. Furthermore, $r = -0.30$, that is a medium-sized negative effect size for “none” versus “5-10” unregistered older legal clarification cases and boundary determination cases. In short, when it comes to unregistered older legal clarification cases and boundary determination cases, it is the transition from “none” to “1-4” or “none” to “5-10” cases, respectively, that determines how demanding it is to register these elderly cases. Thus, hypotheses 4 was also supported by the statistical analysis.

The statistical test show that the technical systems can't be the reason for the backlog of cadastre records of older cases conducted by the land consolidation court (hypothesis 1 was rejected). Nor can it be considered more demanding to register older “land consolidation cases” in the cadastre then it is to register “legal clarification cases” and “boundary determination cases” (hypothesis 2 was rejected). On the other hand, what can explain the backlog of cadastre records of old cases carried out by the land consolidation court is the level of complexity in the case (hypothesis 3 and 4 was supported), but what makes a case complex? The quantitative tests were supplemented with literature, but also free text answers from the respondents. In the following, therefore, the qualitative part of the survey is presented to give an insight into the suggested reasons for the failure to register older cases conducted by the land consolidation courts in Norway.

First, one respondent wrote: *“It is not necessarily the age of the cases that is the reason why they are challenging to register; rather, a case may have become old because it was challenging to register.”* Conversely, another respondent wrote that the complexity of the cases could be due to the fact that they were old: *“Basically, old boundary descriptions from cases carried out by the land consolidation court lack coordinates or are of very poor quality for the purpose of being recorded in the cadastre.”* This indicates the complexity regarding the registration of older cases carried out by the land consolidation courts may arise either when the cases are conducted, or because of the cases' age. Sky and Bjerva (2018, p. 261) show an example of a map sketch from a case conducted by the land consolidation court from 1965 that lacks coordinates (see figure 1), as the respondents described. Sky and Bjerva further write that these maps did not have their own map numbers in the land consolidation court's archive.

The respondents who argued that the cases had a high level of complexity as a result of being old wrote, among other things, that in cases from before the 1980s, boundary descriptions were sent without specifying the coordinates of the boundaries and boundary markers. The start and the end of the boundaries could be vaguely defined. Some municipalities wrote that it was difficult to properly understand the case and that the measurements used are inaccurate today. Due to inaccurate measurements and the lack of emphasis on the property map in the old cases, the municipality must use a greater degree of discretion for the cadastre registration than it does in more recent cases. If the information on which the old case is based is inaccurate, or difficult to interpret, this may lead to inaccurate cadastre records for these cases today.

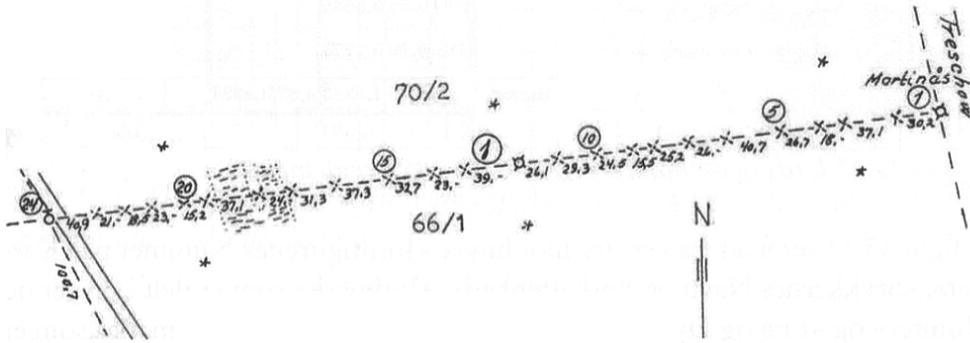


Figure 1. An example of a map sketch showing a case from the land consolidation court in 1965. There are no coordinates available from the map, but the boundary description shows direction and distance between the boundary marks.

(Source: case 0700-1964-0036 Kleiver in Larvik municipality (Vestfold land consolidation court).)

Another important problem which one respondent was aware of was that some easement boundaries were recorded as property boundaries in the cadastre. Furthermore, changes may have been made in the cadastre after older cases were carried out by the land consolidation court. It will therefore be difficult for the municipality to register such cases correctly in relation to the actual conditions today. In fact, the newly entered into force provision about cadastre records of information about existing cadastre unit from older documents, cf. cadastre section section 10b third paragraph, states that the municipality shall ask the parties if they are familiar with later legal transactions on the property that may be important for the cadastre registration. This provision entered into force on January 1, 2021 and indicates that cadastre records of old cases, probably also cases carried out by the land consolidation court, can be demanding, exactly as the respondents claimed some months before the cadastre section section 10b entered in to force. The need for this section also shows that the problem is real, and cadastre records of old cases conducted by the land consolidation court is highly relevant today. Additionally, some respondents wrote that the legislation's strict requirements for notification of the cadastre registration of cases increase their complexity. There can be many parties in a case carried out by the land consolidation court, and landowners may be dead when the cases are old. Furthermore, one respondent wrote that old cases often refer to landowners, instead of cadastre unit numbers. In such cases, the municipality must investigate which property was owned by whom. In addition, one municipality has experienced that the parties no longer understood the judgment or were interested in the case. A couple of respondents also wrote that it is challenging to register old cases carried out by the land consolidation courts, because they have little experience with such cases.

A final point was that 12 out of 50 respondents wrote it is time-consuming to register older cases carried out by the land consolidation courts. One respondent wrote that the municipalities don't have enough capacity to prioritize post-digitization of old cases. Several municipalities agreed with this. One respondent

added that: “*A lack of resources at municipalities makes it challenging to register older cases conducted by the land consolidation courts in the cadastre.*” On the other hand, another respondent wrote that his municipality had converted coordinates/raster maps and checked that no changes had been made to the properties that were parties to the case after the case was closed. In this way, the cadastre had been updated with old cases carried out by the land consolidation court.

5 Discussion

The aim of the article was to consider the backlog in the cadastre registration of older cases conducted by the land consolidation courts in Norway. As the cadastre has the purpose of being an information system for all, I argue that cadastre information must be updated with, among other things, the results of legal proceedings at the land consolidation courts. It is financially unfortunate that cadastre registration has not been carried out in some cases. For example, there may be a risk of new disputes between landowners, delays in construction work, and more. Lack of cadastre records can also have unfortunate socio-economic consequences. Also, those using cadastre data have great confidence in them. If the cadastre is not updated, it can create uncertainty about ownership. Furthermore, decisions can be made on the wrong basis. Public access to information must be ensured. By extension, I argue that it is correct information that should be accessible as the society benefits from this information being accurate.

The first research question was: “*What is the reason for the lack of cadastre registration of older cases conducted by the land consolidation courts in Norway?*” To examine the research question, data collected through a questionnaire survey of Norwegian municipalities were analyzed statistically. The questionnaire also included free- text questions. The respondents’ answers to the free text questions were divided into categories and analyzed.

A total of four hypotheses were tested. Hypothesis 1 was rejected. Thus, the technical system is not the reason for backlog of cadastre registration of old cases carried out by the land consolidation courts.

Hypothesis 2 was also rejected. Thus, it is not considered more demanding to register older “land consolidation cases” in the cadastre than it is to register “legal clarification cases” and “boundary determination cases.”

In contrast, both hypotheses 3 and 4 holds. This means that the backlog in the registration of old land consolidation cases, old legal clarification cases and old boundary determination cases can be explained by the cases’ complexity. Additionally, it was found that it is the change from “none” to “1–4” and “5–10” older unregistered land consolidation cases that affect how demanding it is to register older land consolidation cases. Similarly, it is the transition from “none” to “1–4” or “none” to “5–10” legal clarification cases and boundary determination cases, respectively, that determines how demanding it is to register older legal clarification cases and boundary determination cases.

One reason for the lack of cadastre recording of older cases conducted by the land consolidation court is the difficulty in obtaining an overview of these

cases. This argument was supported by the fact that 67 out of 160 respondents answering the questionnaire didn't know how many older cases conducted by the land consolidation court their municipality had. Furthermore, it was argued that the land consolidation court should have an overview of these cases, as the court had once processed them. A reasonable assumption is that the land consolidation court and the parties were more concerned with having the results of the case recorded in the land register than recorded in the cadastre. Regardless, according to the respondents it is most likely the parties, if anyone, who know the outcome of cases from before the 1970s. This gave rise to another problem: landowners from old cases may be dead today. If the landowners are dead it can create problems, because some cases referred to landowners instead of cadastre unit numbers. Also, some easement boundaries were recorded as property boundaries. In addition to these factors that make it difficult to get an overview of older cases conducted by the land consolidation courts, a lack of coordinates in the boundary descriptions in cases from the 1980s, a lack of emphasis on the cadastre map, and inaccurate measurements, can make it challenging to pursue these old cases today. Furthermore, there may have been changes in the cadastre in the same area as the case was located after it was carried out. With this in mind, it can be assumed that a great effort must be put into "...keeping a uniform and reliable register (cadastre) of all real estate in the country, and that boundaries and property conditions are clarified", cf. Cadastre Act, Section 1, first paragraph.

The methods used seem to cover the needs of this study quite well. The questionnaire covered a large group of respondents at the same time, in a reasonable manner. However, a well-known disadvantage of the chosen method is limited response, which is reflected in this study where 160 of the 354 people invited (45.2 percent) participated in the questionnaire survey. Also, some respondents failed to answer many questions. Additionally, there is no guarantee that the respondents understood the questions correctly. Nevertheless, the results show that the respondents who answered the questionnaire represented a wide range of people: some were working in small municipalities, others in large municipalities, and while some hadn't been working with cadastre records for a long time, many had. The questionnaire gave a particularly good picture of the small and medium-sized municipalities. Fewer large municipalities answered the questions. However, in cities and suburban areas, which often have many residents, the quality of the cadastre is adequate (Pure Logic, 2019, p. 74). Thus, it can be argued that a lack of response from these municipalities may not lead to as big a loss of information as would be the case with a lack of response from municipalities facing problems with large backlogs. Although a relatively small number of respondents have answered the questionnaire, those who did complete it had a solid background for answering these questions. Also, it must be considered that the questionnaire methodology is widely used in Norway. The aim of this article wasn't to generalize, but rather to shed light on an important topic.

From a practical point of view, this article contributes to conveys the respondents' experiences relating to the possible reasons for the backlog in the registration of older cases conducted by the land consolidation courts in the

cadastre. Based on this and previous studies (Pure Logic, 2019, author, 2020), a pattern is revealed: those respondents having a backlog of older cases conducted by the land consolidation court within their municipalities think these cases are challenging to record in the cadastre. The municipalities may not have sufficient resources to carry out the registration of this type of cadastre record, and they cannot charge a fee for such work. It must be added that the quality of today's cadastre can be considered good in some parts of the country. One might also speculate whether an improvement in the quality of the cadastre is worth the expenses it will entail. This is an important political issue.

From a theoretical point of view, this article contributes to uncover a gap in research in Norway, which in my opinion is worth filling. More research is needed to support, reject, or develop the findings in this article. The results of the study further the idea that geodata should be collected and maintained to ensure a uniform and reliable cadastre, in which data can be shared. Admittedly, if cases conducted by the land consolidation court as part of a legal process are not recorded in the cadastre, it can be argued the value chain is incomplete. By this, I mean that spatial data is obtained, among other things, by the land consolidation courts. The cadastre is a database that shall share this information. In Norway, the citizens have great confidence in the government. They trust the information made available by the authorities, and an increasing user group is reliant on this information. The authorities and the cadastre therefore have an important social mission. Citizens believe in what they see. In time, what citizens believe will become true in so far as it is not corrected. It can therefore be argued that there is a need for someone to take responsibility for updating the cadastre with the old cases obtained from the land consolidation courts in Norway that have not yet been registered. This is to ensure that legal decisions are properly implemented. An assessment should be made of who should take responsibility for this.

Finally, the article's second literature study shows that there is a lack of research on the link between cadastre and land consolidation to sustainability, and to the UN sustainability goals, in a Norwegian context. Anyhow, I found a preliminary strategy for increased data quality in the cadastre prepared by the Norwegian Mapping Authority (Gammelmø, 2021). In the strategy, it can be said that the importance of the sustainability goals is recognized. Special reference is made to sustainability goal 17 on cooperation to achieve the goals, and sustainability goal 9 on industry, innovation and infrastructure. However, no plan is proposed to achieve these goals in Norway, as far as I can see. Beyond this, I found no relevant sources that link sustainability to cadastral and land consolidation. The almost missing link is also supported by case law. A simple database search at case law in the land consolidation court gives 1,466 hits. Among these hits, only four court decisions explicitly mention sustainability. It must be taken into account that all four decisions concern cases of change of land, and the database hits provides an overview of all types of cases dealt with by the land consolidation court. As follows from Sky and Lyng (2020, p. 216), today the land consolidation court shall, on its own initiative, ensure that the assessments they make are not in conflict with other legislation. This also include all legislation within nature and

environment. This can, in many ways, be said to be a decline from the previous Land Consolidation Act in Norway. In connection with the Land Consolidation Act from 1979 (Act No. 77 of 21 December 1979) section 29 a, it was specified that consideration should be given to the fact that natural resources should be disposed of based on the needs of future generations. It was also stated that the management of environmental resources should be environmentally sound (Ot. prp. nr. 57, 1997–1998; Sky and Lyng, 2020, p. 214–215).

Anyhow, it would be a natural approach to connect the objective in this article to sustainability. It may be asked why land consolidation and cadastre are not linked more to sustainability in a society where sustainability is emphasized otherwise apparently high on the political agenda. This is mentioned in Sky and Lyng (2020, p. 213) which also discusses that perhaps some of the reasons is that land consolidation in Norway is about the private act conditions, not the public act.

The second literature study may not reveal relevant literature, but it did reveal a clear need for further research. Why is sustainability not mentioned in the land consolidation act, which came into force in 2016? Or in the preparatory work for the act, or subsequent comments on the act? This also reveals an important political issue. I am not aware of anything that indicates that sustainability should not be emphasized in connection with land consolidation and cadastre in Norway. The missing link can be said to be a founding itself, and to me it seems strange that sustainability has not been given more weight in connection with cadastre and in the land consolidation court.

6 Conclusions

To conclude on research question 1, some municipalities have backlogs in the registration of older cases conducted by the land consolidation court in the cadastre. The technical systems cannot explain this. Much of the explanation is historical: the results of some cases from before the 1980s lack coordinates, the boundary descriptions sometimes are vague, the measurements are considered inaccurate, there was little emphasis on the cadastre map, and easement boundaries were sometimes recorded as property boundaries. Furthermore, it's referred to landowners rather than cadastre unit numbers in some cases. Some landowners from the old cases may be deceased. It can be difficult to obtain an overview of older cases conducted by the land consolidation courts that are still not recorded in the cadastre. Many of these cases are considered to be time-consuming to register in the cadastre, as the underlying data in the cadastre may be of lesser quality. Finally, some people working with cadastre records may have little experience of dealing with older cases conducted by the land consolidation courts.

In conclusion to research question 2, an undesirable effect of old legal binding decisions from the land consolidation courts not being registered in the cadastre is that landowners have confidence in information made available from the authority. At home transfers or when landowners die, uncertainties can arise regarding property conditions. Even conflicts between landowners can arise when, for example, one party is familiar with the results from the land consolidation court and the other has confidence in the cadastre map which is publicly available.

Also, conflicts can arise if both landowners are unfamiliar with the results of a case conducted by the land consolidation court. Both mentioned circumstances can lead to claims for a new case and accompanying new costs for the parties. In these cases where a new case is required, hopefully the result of the new case will be registered, and the cadastre will be updated. In other cases, a new case may not be required because the parties are unaware of the varying quality of the cadastre.

The cadastre is a shared component that other services in society benefit from. With imprecise basic information in the cadastre, errors can also spread to the other registers. As citizens believe in what they see, in time what they see will become true as far as it is not corrected. Finally, I would like to point out the importance of the Norwegian Mapping Authority, the municipalities, the land consolidation courts, and the ministries involved gaining an equal understanding of what type of information the cadastre should contain.

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Appendix 1

Table 1. Questions from the questionnaire survey relevant to the study.

Questions from the questionnaire survey relevant to this article	Answer options
Question 1: For how many years have you worked with cadastre registration?	<ul style="list-style-type: none"> <input type="radio"/> < 3 years <input type="radio"/> 3–5 years <input type="radio"/> 6–10 years <input type="radio"/> 11–15 years <input type="radio"/> > 15 years
Question 3: How large an area does your municipality have?	<ul style="list-style-type: none"> <input type="radio"/> < 500 km² <input type="radio"/> 501–1,000 km² <input type="radio"/> 1,001–1,500 km² <input type="radio"/> 1,501–2,500 km² <input type="radio"/> > 2,500 km² <input type="radio"/> Don't know
Question 4: How many residents are there in your municipality?	<ul style="list-style-type: none"> <input type="radio"/> < 5,000 residents <input type="radio"/> 5,000–9,999 residents <input type="radio"/> 10,000–19,999 residents <input type="radio"/> 20,000–49,999 residents <input type="radio"/> 50,000–149,999 residents <input type="radio"/> 150,000 residents or more <input type="radio"/> Don't know
Question 7: Which technical solution (s) (client) does your municipality use for cadastre records of older cases carried out by the land consolidation court?	<ul style="list-style-type: none"> <input type="radio"/> The technical solution developed by the Norwegian Mapping Authority <input type="radio"/> The technical solution developed by Norkart Geoservice AS (GISLINE) <input type="radio"/> The technical solution developed by Norconsult Information system AS <input type="radio"/> Both the technical solution developed by the Norwegian Mapping Authority and, the technical solution developed Norkart <input type="radio"/> Both the technical solution developed by the Norwegian Mapping Authority and, the technical solution developed Norconsult <input type="radio"/> Both the technical solution developed by Norkart and the technical solution developed Norconsult <input type="radio"/> All three solutions
Question 8: How satisfied are you with the technical solution(s) (client) that your municipality uses, regarding cadastre registration of cases carried out by the land consolidation court?	<ul style="list-style-type: none"> <input type="radio"/> Very satisfied <input type="radio"/> Satisfied <input type="radio"/> Neutral <input type="radio"/> Dissatisfied <input type="radio"/> Very dissatisfied